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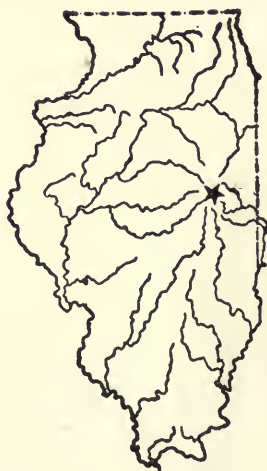
BULLETIN No. 172

A STUDY OF THE DIGESTIBILITY OF RATIONS FOR STEERS

WITH SPECIAL REFERENCE TO THE INFLUENCE OF
THE CHARACTER AND THE AMOUNT OF
FEED CONSUMED

By H. W. MUMFORD, H. S. GRINDLEY, L. D. HALL,
AND A. D. EMMETT

WITH THE COLLABORATION OF
W. E. JOSEPH AND H. O. ALLISON



URBANA, ILLINOIS, JUNE, 1914

CONTENTS OF BULLETIN No. 172

	PAGE
1. THE EXPERIMENT:	
(a) Plan: The animals. Rations and feeds. Equipment. Weighing and sampling of feeds. Refused feeds or orts. Collection and sampling of feces. Methods of analysis.....	235
(b) Average amounts of feeds offered daily per period.....	241
(c) Weights of orts.....	243
(d) Composition of the feeds.....	243
(e) Feeds and nutrients consumed.....	244
(f) The feces and their constituents.....	245
(g) Amounts of nutrients digested.....	246
2. COEFFICIENTS OF DIGESTIBILITY:	
(a) Dry substance	246
(b) Carbohydrates	251
(c) Crude protein	251
(d) Crude fat	255
3. SUGGESTIONS IN REGARD TO METHODS OF CONDUCTING DIGESTION EXPERIMENTS	258
4. SUMMARY	260
5. CONCLUSIONS	262
6. APPENDIX:	
(a) Table 1.—Total feed and nutrients offered and consumed during the test periods.....	265
(b) Table 2.—Total feces and total nutrients voided in the feces during the test periods.....	269
(c) Table 3.—Total nutrients digested during the test periods	270
(d) Table 4.—Coefficients of digestibility of dry substance for each period	271
(e) Table 5.—Coefficients of digestibility of carbohydrates for each period	273
(f) Table 6.—Coefficients of digestibility of crude protein for each period	275
(g) Table 7.—Coefficients of digestibility of crude fat for each period	277
(h) Figures illustrating rear and front of stalls and method of sampling feces	279
(i) Curves for coefficients of digestibility of dry substance, carbohydrates, crude protein, and crude fat.....	283

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This bulletin is one of a series reporting the findings of an investigation in regard to the effect of variations in the character and amount of feed consumed upon the nutrition of steers. It gives the results relating to the effect upon the coefficients of digestibility (1) of variations in the proportions of roughage and concentrates in the ration, (2) of the substitution of a nitrogenous concentrate for a part of the grain of a ration of roughage and grain in the ratio of 1:5, and (3) of variations in the amount of feed consumed from maintenance rations to full feed.

THE EXPERIMENT

The Animals.—The animals used were eight two-year-old high-grade Hereford steers, grading as choice feeders, and weighing from 800 to 1,000 pounds. These animals were selected from the same herd. From birth to the time of purchase they had been treated very much alike. During a period of about two months preliminary to the experiment they were kept in paved lots with access to open sheds, and during the experiment proper, which lasted from May 27 to December 23, a period of thirty weeks, they were kept in digestion and metabolism stalls.

Rations and Feeds.—During the first month of the period preliminary to the experiment the ration consisted of corn silage, clover hay, and alfalfa hay. At the beginning of the second month ground corn was added to the ration, and the feeding of alfalfa was discontinued. Four days later the feeding of corn silage was discontinued. During the first twenty-two weeks of the experiment proper the ration consisted of clover hay and ground corn, and during the last eight weeks, of clover hay, ground corn, and linseed oil meal. Half an

ounce of salt, given daily, was taken very consistently by all of the steers. Water also was given twice daily, and an exact record was kept of the amounts drunk.

To determine the effect of variations in the proportions of roughage to concentrates in the ration upon its digestibility, and the effect of the introduction of linseed oil meal into the ration, the experiment was divided into four test periods. During the first test period the ration consisted of clover hay and ground corn in equal amounts; during the second, of one part of clover hay and three parts of ground corn; during the third, of one part of clover hay and five parts of ground corn; and during the fourth, of one part of clover hay, four parts of ground corn, and one part of linseed oil meal. Thus the proportion of concentrates was gradually increased up to the third test period, and then maintained constant to the end of the experiment. These changes are comparable to the changes often made in the proportions of roughage and concentrates in ordinary feeding practice. The first test period was three weeks in length, and the second, third, and fourth, each four weeks in length. The proportions of the feeds to be used in each test period were fed first in a preliminary period of two weeks immediately preceding the test period, and the changes in the ration to be made from one test period to another were effected very gradually in transitional periods one of which immediately followed each test period. The first and third transitional periods were two weeks in length, and the second, three weeks in length. Table 1 gives the division of the experiment into periods and the proportion of roughage to concentrates fed in each.

TABLE 1.—DIVISION OF EXPERIMENT INTO PERIODS, AND RATIOS OF CLOVER HAY, GROUND CORN, AND LINSEED OIL MEAL FED DURING EACH

Feeding period	Experimental weeks	Number of weeks in period	Ratio of clover hay to ground corn to linseed oil meal
Preliminary	1- 2	2	1:1 :0
Test	3- 5	3	1:1 :0
Transitional	6- 7	2	1:1.9:0
Preliminary	8- 9	2	1:3 :0
Test	10-13	4	1:3 :0
Transitional	14-16	3	1:3.9:0
Preliminary	17-18	2	1:5 :0
Test	19-22	4	1:5 :0
Transitional	23-24	2	1:4.4:0.6
Preliminary	25-26	2	1:4 :1
Test	27-30	4	1:4 :1

To determine the effect of variations in the amount of feed consumed upon the digestibility of the rations, the eight steers were divided into four lots of two animals each, and each lot was given

thruout the experiment an amount of feed different from that received by the other lots. The lots were as similar as possible in regard to age, condition, and breeding of the animals. One was given just enough feed to maintain the weights of the steers about constant; another, as much as the steers would eat readily; another, an amount of feed equal to the maintenance ration plus one-third of the difference between the maintenance and the full-feed rations; and another, an amount equal to the maintenance ration plus two-thirds of the difference between the maintenance and full-feed rations. In the discussion and tables of this bulletin the first of the above-described lots has been designated as the "maintenance" lot; the second, as the "full-feed" lot; the third, as the "one-third-feed" lot; and the fourth, as the "two-thirds-feed" lot.

Equipment.—Since metabolism studies were to be carried out with the same animals, careful provision was made for the collection of the urine as well as of the feces. The digestion and metabolism stalls were further arranged to prevent loss of feed while the steers were eating. The following description of the stalls and other apparatus deals more especially with the features that were found to be most useful in carrying out the work.

The digestion stalls were in general similar to those used by Armsby¹ of the Pennsylvania Station. They differed, however, in the floor covering, the feed boxes, and the stanchions. Further, since at the time of defecation, the feces were caught in a specially prepared shovel by an attendant, there was no need for the opening in the floor which was used by Armsby and others to permit the rubber feces-duct to pass thru. The stalls were of such length that the steers had but little room to move backward or forward. It was, therefore, impossible for them to pull the urine funnels out of the floor opening.

The stall floor proper was about three feet above that of the barn. This arrangement made it possible to construct a movable support for the urine pails which could be reached without much difficulty when the daily exchange of vessels was made.

The feed boxes were constructed on the plan of a drawer which could be pushed in at feeding time and pulled out and locked in place as soon as the animal finished eating. As a result of this arrangement the steer had much more freedom while lying down. The feed boxes were made of wood and lined with removable galvanized iron boxes. In order that no feed might become lodged in the corners, the bottoms of the metal boxes were rounded at the sides, the side toward the steer was set at a slight angle with the vertical, and the edges of the box were flanged to extend just beyond the wooden frame.

¹Pa. Agr. Exp. Sta. Bul. 42, page 74 (1898).

Another safeguard against loss of feed was the stanchion arrangement. This consisted of two hinged gates, one hung on each side of the front end of the stall. To the free ends of the stanchions heavy canvas was attached and fastened to the sides of the stall-post above the space where the feed box slid in. During feeding the gates were brought together until they held the steer's head in place. The canvas on each side made it practically impossible for the feed to be thrown out of the box.

The flooring was made up of several layers: first, a layer of excelsior; next, a layer of quarter-inch cork; next, a layer of heavy linoleum; and last, as a protection to the linoleum, a layer of imitation leather called "pantasote." This combination gave very satisfactory results and in the long run was not very expensive. The advantages of such a floor were that it did not break or crack, it could be kept perfectly clean, and it was not easily torn or pulled loose.

The catch pans were of galvanized iron, and the feces shovel was of heavy tin. The shovel measured ten by fifteen inches. For removing the feces from the shovel a scraper was provided. Enamel-ware cans, thirteen inches in diameter and eighteen inches in height, were used for feces cans. Special, closely-fitting, covers were provided to prevent loss of moisture. The feces were mixed in a specially-made galvanized-iron box set upon a wheelbarrow. Half-gallon paint cans with friction-top lids were used for feces sample pails.

The strictest attention was given to such matters as the cleanliness of all apparatus and equipment, the sanitary conditions, and the comfort of the steers during the progress of the experiment. All apparatus was carefully cleaned after being used, and the stalls were thoroughly brushed each day when the steers were weighed. Flies were kept out during the warm summer months by the use of screens. The windows were kept open at all times, even during the coldest weather.

Photographs of the stalls will be found in the Appendix, Figures 1a, 1b, and 1c.

Weighing and Sampling of Feeds.—The weighing and sampling of the feeds were carried out as follows:

Clover Hay.—A quantity of the baled hay, sufficient to last at least four weeks, was cut in an ensilage cutter into lengths of one inch or less. The entire lot was then put into a small room, and each week a portion was removed, mixed, weighed, and sampled as follows:

The amount that would be needed during the subsequent experimental week was spread out to a thickness of one foot on the clean barn floor. It was then shoveled systematically by two men who stood on opposite sides of it and threw shovelfuls alternately into one pile. It was next spread out again, divided into quarters, mixed from opposite sides, and the two resulting piles combined into one. This last procedure was repeated twice. The hay was then spread out and divided into three approximately equal lots.

The weighing of the hay was begun immediately after it had been thoroly mixed. The feed sheets were made out in advance of the experimental week, but as late as possible in order that they might contain any necessary changes. Individual feeds of hay were weighed for every morning and evening of an entire week. Special care was taken in the weighing to have the individual feeds of hay as nearly uniform in character as possible. With this in view, a part of each feed was taken from each of the three piles. The individual feeds were kept in small bags of heavy bed ticking. After the weighing of every two feeds, a small portion of the chaffed hay was taken from the front part of each pile for a composite sample.

Tests of the thoroness of this method of weighing and sampling the feed indicated that the individual portions were remarkably uniform in composition.

After the individual feeds had been weighed, the portion of hay taken for a composite sample was quartered and subdivided until it was reduced to a comparatively small lot. One sample of about five pounds was then taken for air drying, and another for direct chemical examination.

Ground Corn.—The ground corn used thruout the experiment was of the yellow dent variety and was ground to medium fineness. It was spread out on the clean floor, mixed, weighed, and sampled in exactly the same manner as the chopped clover hay.

Linseed Meal.—Pea-size old-process linseed meal was ground to medium fineness and put up for the steers in the same way as the hay and ground corn, except that it was kept in tightly covered tin pails instead of cloth bags.

Refused Feeds or Orts.—The feed boxes were carefully swept out every day, and any appreciable amount of orts was removed before the next feed was offered. The orts were transferred to tared, friction-top paint cans properly labelled with the number of the animal and the date of the experimental week. Every day each of these was weighed and hung in front of the proper stall.

When sufficient in quantity to influence the results, the combined orts for the experimental week were thoroly mixed, and, if necessary, quartered until reduced to a workable amount. The sample was then air-dried in the electric oven, and after being weighed, was ground and analyzed.

Collection and Sampling of Feces.—The feces were collected in a special tin shovel at the time of defecation and then transferred to a tared enamel-lined can provided with a closely fitted cover. The shovel, can, cover, and scraper were each given a number corresponding to that of the steer for which they were provided. Also, in order that the feces of one animal might not become mixed with those of

another, the shovels were fastened to the proper stalls. At the end of every experimental day, the shovels, cans, and scrapers were replaced with clean, dry ones, and the empty cans were weighed. Next, the cans from the preceding day were weighed, and the feces mixed in the specially-made wheelbarrow as shown in Fig. 2 in the Appendix. Great care was taken to scrape the can out thoroly. For this purpose a special scraper was made. After the feces had been mixed for three minutes, a definite portion of the total amount was taken as the daily fraction. This proportion of the feces taken daily during the experimental week was one-tenth to one-fifth for the maintenance steers, one-tenth for the one-third-feed and two-thirds-feed steers, and one-twenty-fifth for the full-feed steers. The fraction, obtained by taking small portions at random thruout the entire mixed lot, was put into a tared friction-top paint can which had been treated with a 10 percent alcoholic thymol solution and dried. When the proper amount of feces had been weighed out, approximately five grams of finely-ground thymol were added and thoroly mixed with the sample.

Each lot of the feces was weighed and sampled in this manner. After the eight lots had been sampled, the pails, which were labelled with the animal number, the day, and the experimental week, were put into a cold storage room the temperature of which was about 1° to 3° C.

At the end of every experimental week the seven daily samples for each of the eight steers were taken out of storage. These fractional samples were then transferred to the wheelbarrow. Special care was taken to recover the fraction as completely as possible. After the combined fractions were thoroly mixed, two composite-samples were taken—one in a thymoled pail and the other in a tared enamel pan. The first was sent to the laboratory for chemical analysis. The second was dried in an electric oven for a week at 55° to 60° C., and while being dried was stirred daily. On being removed from the oven it was put into a friction-top pail, sealed with paraffin, labelled, and placed in cold storage.

Methods of Analysis.—The methods of analysis used in this experiment were essentially the same as the official methods given in the revised edition for 1908 of Bulletin 107 of the Bureau of Chemistry, United States Department of Agriculture. The carbohydrates were determined by difference, as no determinations were made for crude fiber.

AVERAGE AMOUNTS OF FEEDS OFFERED DAILY PER PERIOD

The average amounts of feed offered daily per period are given in Table 2.

Maintenance.—While it was planned to give the maintenance steers, just enough feed to keep their weights practically constant, they gained about 0.5 pound per day during the entire experiment. The daily amounts of ground corn fed to each were increased from 5.50 pounds at the beginning of the experiment to 7.00 pounds during the third test period, and from the third test period were reduced to 5.52 pounds at the end of the experiment. The amount of oil meal fed to each during the final test period was 1.38 pounds. The clover hay was reduced from 5.50 pounds at the beginning of the experiment to 1.40 pounds during the third preliminary period, and was maintained practically constant from the third preliminary period to the end of the experiment.

One-Third Feed.—At the beginning of the experiment Steer 666 received 7.62 pounds each of ground corn and clover hay, and Steer 669, 7.87 pounds. The maximum amount of ground corn received by Steer 666 was reached during the second test period, when the average daily quantity was 11.12 pounds. After that time there was a more or less regular decrease to 8.00 pounds at the end of the experiment. In the case of Steer 669 the maximum amount of corn was reached during the second transitional period when he received daily 11.82 pounds. In the final test period Steer 666 received 2.00 pounds of the oil meal, and Steer 669, 2.16 pounds. The amounts of clover hay decreased from 7.62 pounds for Steer 666 and 7.87 pounds for Steer 669 at the beginning of the experiment to 2.00 pounds for Steer 666 and 2.16 pounds for Steer 669 at the end of the experiment.

Two-Thirds Feed.—The ground corn for Steers 652 and 665 increased from 9.87 and 10.25 pounds, respectively, at the beginning of the experiment, to 15.31 and 16.42 pounds during the second test period, and decreased from the second test period to 10.48 and 11.76 pounds, respectively, at the end of the experiment. The amounts of oil meal fed these steers during the final test period were 2.62 and 2.94 pounds, respectively. The amounts of clover hay decreased irregularly from 9.87 and 10.25 pounds at the beginning of the experiment to 2.62 and 2.94 pounds, respectively, at the end of the experiment.

Full Feed.—At the beginning of the experiment Steers 663 and 661 received daily 12.00 and 12.50 pounds of the ground corn, respectively. These amounts were gradually increased until, in the second test period, they were given 19.59 and 21.18 pounds, respectively. Then followed a more or less regular decrease to the end of the experiment, at which time Steer 663 received 12.96 pounds, and Steer 661, 14.88 pounds. The amounts of oil meal fed during the last test period were 3.24 pounds to Steer 663, and 3.72 pounds to Steer 661. At the beginning of the experiment the amounts of clover hay and ground

TABLE 2.—AVERAGE FEED OFFERED DAILY PER PERIOD
(Results expressed in pounds)

Lot	Animal	Feed	Preliminary	Test	Transitional	Preliminary	Test	Transitional	Preliminary	Test	Transitional	Preliminary	Test
Maintenance	650	Clover hay....	5.50	5.51	3.53	2.28	2.28	1.77	1.40	1.40	1.40	1.40	1.38
		Ground corn...	5.50	5.51	6.54	6.84	6.84	6.84	7.00	7.00	6.22	5.60	5.52
		Oil meal.....	...	...	...	...	...	...	...	...	0.78	1.40	1.38
One-third feed	656	Clover hay....	5.50	5.51	3.61	2.28	2.28	1.77	1.40	1.40	1.40	1.40	1.38
		Ground corn...	5.50	5.51	6.70	6.84	6.84	6.84	7.00	7.00	6.21	5.60	5.52
		Oil meal.....	...	...	...	...	...	...	...	...	0.74	1.40	1.38
One-third feed	666	Clover hay....	7.62	7.78	5.19	3.55	3.71	2.77	2.14	2.09	2.00	2.00	2.00
		Ground corn...	7.62	7.78	9.76	10.64	11.12	10.70	10.70	10.45	8.83	8.00	8.00
		Oil meal.....	...	...	...	...	...	...	...	...	1.17	2.00	2.00
Two-thirds feed	659	Clover hay....	7.87	7.99	5.50	3.70	3.87	3.05	2.36	2.25	2.16	2.16	2.16
		Ground corn...	7.87	7.90	10.29	11.08	11.60	11.82	11.80	11.25	9.53	8.64	8.64
		Oil meal.....	...	...	...	...	...	...	...	...	1.27	2.16	2.16
Two-thirds feed	652	Clover hay....	9.87	10.06	6.87	4.81	5.10	3.78	2.90	2.81	2.60	2.60	2.62
		Ground corn...	9.87	10.06	12.99	14.44	15.31	14.56	14.50	14.05	11.46	10.40	10.48
		Oil meal.....	...	...	...	...	...	...	...	...	1.55	2.60	2.62
Full feed	665	Clover hay....	10.25	10.47	7.32	5.10	5.47	4.25	3.34	3.13	2.92	2.92	2.94
		Ground corn...	10.25	10.47	13.80	15.32	16.42	16.44	16.70	15.65	12.87	11.68	11.76
		Oil meal.....	...	...	...	...	...	...	...	...	1.73	2.92	2.94
Full feed	663	Clover hay....	12.00	12.34	8.54	6.08	6.53	4.53	3.64	3.50	3.20	3.20	3.24
		Ground corn...	12.00	12.34	16.21	18.24	19.59	17.43	18.20	17.50	14.07	12.80	12.96
		Oil meal.....	...	...	...	...	...	...	...	...	1.93	3.20	3.24
Full feed	661	Clover hay....	12.50	12.82	8.24	6.52	7.06	5.28	4.22	3.98	3.68	3.68	3.72
		Ground corn...	12.50	12.82	17.42	19.56	21.18	20.40	21.11	19.90	16.20	14.72	14.88
		Oil meal.....	...	...	...	...	...	...	...	...	2.20	3.68	3.72

corn fed were the same. Later the quantity of hay was gradually reduced as the ground corn was increased. In the final test period Steer 663 received 3.24 pounds of the clover hay, and Steer 661, 3.62 pounds.

While the full-feed ration given in this experiment was as much as the steers would consume, it was a little less than the amount ordinarily regarded as full feed for steers of the same age and weight. The smaller consumption of feed by these steers may have been due to their close confinement in the stalls.

WEIGHTS OF ORTS

In Table 3 are given the total orts. The only animals that left large quantities of orts at any time were Nos. 663 and 661. During the first period No. 663 left about one-third of his feed, and at other times, as much as one-sixth. In the third preliminary and test periods No. 661 left about fifteen percent of his feed.

TABLE 3.—TOTAL ORTS PER PERIOD
(Results expressed in pounds)

Period		Ratio of hay to corn to oil meal	Maintenance		One-third feed		Two-thirds feed		Full feed	
Description	Experimental weeks		650	656	666	669	652	665	663	661
Preliminary . . .	1- 2	1:1:0	....	....	....	....	0.71	0.80	110.57	....
Test	3- 5	1:1:0	....	....	....	....	0.47	0.21	26.40	3.82
Transitional . . .	6- 7	1:1.9:0	....	....	....	....	0.29	8.61	77.16	3.54
Preliminary . . .	8- 9	1:3:0	....	....	....	....	0.30	....	0.73	0.34
Test	10-13	1:3:0	....	0.61	....	....	0.31	....	105.84	20.89
Transitional . . .	14-16	1:3.9:0	....	....	....	....	....	....	43.27	37.98
Preliminary . . .	17-18	1:5:0	....	....	....	....	0.86	....	57.73	68.37
Test	19-22	1:5:0	....	....	....	....	....	....	64.92	85.79
Transitional . . .	23-24	1:4.4:0.6	....	....	....	....	....	....	....	....
Preliminary . . .	25-26	1:4:1	....	....	....	....	....	....	34.37	....
Test	27-30	1:4:1	....	....	....	....	....	....	69.47	....

COMPOSITION OF THE FEEDS

In Table 4 is given the average composition of the feeds used in this experiment. The composition of the oil meal was practically the same as that given in the revised edition (1912) of Henry's "Feeds and Feeding." The ground corn was somewhat lower in dry substance, about 2.6 percent lower in protein, 1.6 percent higher in carbohydrates, and slightly lower in fat and ash. The clover hay was about 3.8 percent higher in dry substance, about 1.3 percent lower in protein, 6.8 percent higher in carbohydrates, about 0.9 percent lower in fat, and 0.8 percent lower in ash. On the basis of the protein content, both the ground corn and the clover hay were poorer in quality than the average for these feeds.

TABLE 4.—AVERAGE COMPOSITION OF FEEDS
(Results expressed in percent of fresh substance)

Feed	Dry substance	Crude protein (N x 6.25)	Total carbohydrates	Fat (ether extract)	Ash	Total nitrogen	Phosphorus
Ground corn	87.09	7.69	74.21	3.93	1.27	1.230	0.263
Linseed meal	90.74	34.80	43.72	6.79	5.42	5.564	0.869
Clover hay	88.46	10.97	69.75	2.36	5.39	1.756	0.153

FEEDS AND NUTRIENTS CONSUMED

In Table 1 of the Appendix are given the amounts of feeds and the nutrients offered and consumed during the test periods. In studying this table it should be borne in mind that the first test period lasted only three weeks, while the second, third, and fourth were each four weeks in length. Also, that as a result of the changes in the proportion of concentrates to roughage in the ration from period to period, the amounts of nutrients supplied by the concentrates were increased, and the amounts supplied by the roughage were decreased, up to the third test period, and both were then maintained constant from the third period to the end of the experiment.

The amounts of feed consumed per week remained practically constant from the first test period to the second, decreased about 14 percent from the second to the third, and remained practically constant again from the third to the fourth.

The amounts of dry substance and carbohydrates consumed per week, like the amounts of feed, remained practically constant from the first period to the second, and decreased about 13 percent from the second period to the third. From the third period to the fourth, the dry substance, like the amounts of feed consumed, remained about constant, while the carbohydrates decreased considerably. The decrease in the carbohydrates was due to the relatively low carbohydrate content of the oil meal as compared with that of the ground corn which the oil meal replaced in the ration.

The amounts of ash consumed per week decreased markedly from the first period to the third, and increased markedly from the third to the fourth. These changes were due to the lower ash content of the ground corn as compared with that of the clover hay and that of the oil meal.

The fat consumed per week increased moderately from the first period to the second because of the higher fat content of the ground corn as compared with that of the clover hay. From the second period

to the third, however, altho the proportion of ground corn in the ration was again increased, there was practically no change, as the increase in the percentage of fat in the ration was offset by the reduction in the amounts of feed consumed. In the fourth period there was a slight decrease for all of the steers except one.

Because of the lower protein content of the ground corn as compared with that of the clover hay, and because of the decrease in the amount of feed consumed, the amount of protein consumed per week decreased moderately from the first period to the third. From the third period to the fourth, it increased markedly on account of the high protein content of the oil meal.

THE FECES AND THEIR CONSTITUENTS

In Table 2 of the Appendix are given the weights of the feces and the nutrients voided in the feces.

The amounts of feces excreted per week decreased markedly from the first period to the third, and decreased moderately from the third to the fourth. The changes were due probably to decreases in the crude fiber of the ration from period to period.

The dry substance and carbohydrates decreased moderately from the first period to the second, decreased markedly from the second to the third, and decreased moderately again from the third period to the fourth. The changes were due to the fact that the digestibility of the dry substance and carbohydrates increased as the proportion of roughage in the ration was decreased.

The ash in the feces per week, like the ash consumed, decreased markedly from the first period to the third. From the third period to the fourth, however, even tho the ash consumed increased markedly, the ash of the feces increased only very slightly, either because the ash of the oil meal was more completely absorbed than the ash of the ground corn, or because more of the metabolic ash was excreted in the urine.

The fat content of the feces remained practically constant from the first period to the second, decreased moderately from the second to the third, and remained practically constant again from the third to the fourth.

The protein in the feces per week decreased somewhat more markedly from the first period to the third than the protein consumed. From the third period to the fourth, because of the greater digestibility of the protein of the oil meal as compared with that of the protein of the ground corn, the amounts of protein in the feces remained about constant, even tho much more protein was consumed in the fourth period than at any other time during the experiment.

AMOUNTS OF NUTRIENTS DIGESTED

Table 3 of the Appendix gives the amounts of nutrients digested during the test periods.

The amounts of dry substance and carbohydrates digested per week increased slightly from the first period to the second, decreased slightly from the second to the third, and decreased slightly from the third to the fourth.

The amounts of fat digested per week increased moderately from the first period to the second, increased slightly from the second to the third, and, with the exception of the quantities digested by one steer, decreased slightly from the third period to the fourth.

The protein digested per week decreased slightly from the first period to the second, and decreased moderately from the second to the third. From the third period to the fourth there was a marked increase, which explains why the amounts of protein in the feces remained constant from the third period to the fourth when much more protein was consumed during the fourth period than during the third.

COEFFICIENTS OF DIGESTIBILITY OF DRY SUBSTANCE

In Table 5 are given the coefficients of digestibility of the dry substance during the test periods. These data were compiled from the weekly data which are represented by Figs. 3 and 5 of the Appendix and are given in detail in Table 4, page 271 of the Appendix.

Effect of Character of Ration

The coefficients of digestibility of the dry substance increased from the beginning to the end of the experiment. It is evident, therefore, that the dry substance of the ration of clover hay and ground corn in the ratio of 1:3 was more digestible than that of the ration of clover hay and ground corn in the ratio of 1:1; that the dry substance of the ration of clover hay and ground corn in the ratio of 1:5 was more digestible than that of the ration of clover hay and ground corn in the ratio of 1:3; and that the dry substance of the ration of clover hay, ground corn, and linseed oil meal in the ratio of 1:4:1 was more digestible than that of the ration of clover hay and ground corn in the ratio of 1:5. These facts, therefore, confirm the results obtained in numerous other experiments which have shown that the dry substance of ground corn is more digestible than the dry substance of clover hay, and the dry substance of linseed oil meal, more digestible than the dry substance of ground corn.

That the character of the ration affected also the influence exerted by the amounts of feed consumed on the coefficients of digestibility of the ration will be evident from the discussion of this subject given on page 250.

TABLE 5.—COEFFICIENTS OF DIGESTIBILITY OF DRY SUBSTANCE
(Results expressed in percent)

Period	Pre-lim-inary	Test	Aver-age	Transi-tional	Pre-lim-inary	Test	Aver-age	Transi-tional	Pre-lim-inary	Test	Aver-age	Transi-tional	Pre-lim-inary	Test	Aver-age
Experimental weeks	1-2	3-5	1-5	6-7	8-9	10-13	8-13	14-16	17-18	19-22	17-22	23-24	25-26	27-30	25-30
Ratio of hay to corn to oil meal	1:1:0	1:1:0	1:1:0	1:1.9:0	1:3:0	1:3:0	1:3:0	1:3.9:0	1:5:0	1:5:0	1:5:0	1:4.4:0.6	1:4:1	1:4:1	1:4:1
Maintenance	67.44	69.30	68.56	71.15	78.06	76.34	76.91	76.80	78.20	78.50	78.40	80.34	79.48	80.64	80.25
" "	69.01	70.69	70.02	74.19	79.21	78.22	78.55	79.13	79.10	79.08	79.09	79.21	77.90	79.35	78.87
Average	68.22	69.99	69.29	72.67	78.63	77.28	77.73	77.96	78.65	78.79	78.74	79.77	78.69	79.99	79.56
One-third feed.....	69.89	67.98	68.7*	67.28	73.06	72.39	72.62	73.35	74.78	75.26	75.10	78.09	77.56	77.77	77.70
" "	58.34	66.26	63.09	67.55	69.98	71.73	71.15	72.00	77.10	76.22	76.51	75.79	75.28	76.52	76.11
Average	64.11	67.12	65.91	67.42	71.52	72.06	71.88	72.68	75.94	75.74	75.80	76.94	76.42	77.14	76.90
Two-thirds feed.....	61.54	65.85	64.13	67.86	69.00	69.56	69.37	72.84	77.24	75.57	76.13	78.23	77.30	77.80	77.64
" "	60.80	65.40	63.56	67.12	67.65	68.58	68.27	67.67	69.94	71.67	71.09	70.49	72.52	72.40	72.44
Average	61.17	65.62	63.84	67.49	68.32	69.07	68.82	70.25	73.59	73.62	73.61	74.36	74.91	75.10	75.04
Full feed.....	62.12	64.50	63.55	64.75	68.66	69.64	69.31	70.14	72.57	74.81	74.06	75.62	78.20	79.53	79.09
" " .....	....	61.55	....	60.83	61.19	59.49	60.06	60.80	65.10	65.42	65.31	68.69	73.36	72.71	72.93
Average .....	....	63.03	....	62.78	64.92	64.56	64.68	75.47	68.83	70.11	69.68	72.15	75.78	76.12	76.01
Grand average	64.16	66.44	65.95	67.59	70.85	70.74	70.78	71.59	74.25	74.56	74.46	75.81	76.45	77.09	76.88

Effect of Amounts of Feed Consumed

First Test Period.—In the first test period the average coefficients for the four lots of animals were as follows: maintenance lot, 69.99; one-third-feed lot, 67.12; two-thirds-feed lot, 65.62; and full-feed lot, 63.03. Therefore, the lot coefficients varied inversely as the amounts of feed consumed. The coefficients for the individual animals were: in the maintenance lot, 69.30 and 70.69; in one-third-feed lot, 67.98 and 66.26; in the two-thirds-feed lot, 65.85 and 65.40; and in the full-feed lot, 64.50 and 61.55. From these figures it will be noted that the differences between the values for the single animals were less marked than those between the lots. In a number of cases one value in a lot was nearer to one or both of the coefficients in another lot than to the other coefficient of the same lot; thus, the coefficient for Steer 663 was nearer to the coefficients of the two-thirds-feed lot than to the coefficient of Steer 661. No. 663 consumed less feed than Steer 661, but the amount was not enough less to account for the difference of practically 3 percent between their coefficients. The coefficients of the two-thirds-feed lot agreed with each other much more closely than did those of the one-third-feed lot or those of the maintenance lot. In spite of the differences between the values for the individual animals, however, the fact that the coefficients for the lots tended to vary inversely as the amount of feed consumed and that the variation was progressive from the maintenance lot to the full-feed lot, is conclusive evidence that an increase above the maintenance requirement in the amount of feed consumed in the first test period caused a decrease in the digestibility of the nutrients of the ration.

Second Test Period.—The lot averages for the second test period were as follows: maintenance, 77.28; one-third feed, 72.06; two-thirds feed, 69.07; and full feed, 64.56. In this period, as in the first test period, the average coefficients varied inversely as the amounts of feed consumed. The coefficients for the individual animals were: in the maintenance lot, 76.34 and 78.22; in the one-third-feed lot, 72.39 and 71.73; in the two-thirds-feed lot, 69.56 and 68.58; and in the full-feed lot, 69.64 and 59.49. In the full-feed lot the difference between the coefficients for the two animals was marked, while in the other lots the differences were quite small. The marked difference between the values for Steers 663 and 661 may be explained only in part by the differences in the amounts of dry substance they consumed. Notwithstanding these differences between individual animals, however, the data indicate that in the second test period an increase in the amount of feed consumed from maintenance to one-third-feed and from one-third feed to two-thirds feed resulted in a decrease in the coefficients of digestibility of the dry substance. An increase from two-thirds feed to full feed, on the other hand, apparently had little effect.

Third Test Period.—In the third test period, the lot averages of the coefficients were: maintenance, 78.79; one-third feed, 75.74; two-thirds feed, 73.62; and full feed, 70.11. The values for the individual animals were: in the maintenance lot, 78.50 and 79.08; in the one-third-feed lot, 75.26 and 76.22; in the two-thirds-feed lot, 75.57 and 71.67; and in the full-feed lot, 74.81 and 65.42. The difference between the two coefficients in the full-feed lot was very great, and that between the coefficients in the two-thirds-feed lot was large. Because of these differences within the lots, the differences between the one-third-feed, the two-thirds-feed, and the full-feed lots cannot be considered significant with respect to differences in the amounts of feed consumed as a cause. The coefficient of the maintenance lot in the third period, as in the preceding test periods, was still distinct from those of the other lots, but in this case the differences were smaller.

From these facts it seems evident, therefore, that in the third test period the dry substance of the maintenance ration may have been digested more thoroly than that of the heavier rations, altho the differences in the coefficients were not as significant as those found in the previous test periods.

Fourth Test Period.—In the fourth test period the average coefficients for the four lots were as follows: maintenance lot, 79.99; one-third-feed lot, 77.14; two-thirds-feed lot, 75.10; and full-feed lot, 76.12. Except that the value representing the two-thirds-feed lot was lower than that of the full-feed lot, the coefficients varied inversely as the amount of feed consumed. The coefficients for the individual animals were: in the maintenance lot, 80.64 and 79.35; in the one-third-feed lot, 77.77 and 76.52; in the two-thirds-feed lot, 77.80 and 72.40; and in the full-feed lot, 79.53 and 72.71. On the basis of these values, no lot was very different from the others. The maintenance lot was the most distinct, but one value in the full-feed lot was lower than that for Steer 650, and higher than that for Steer 656.

Therefore, the data indicate that during the fourth test period, little or no difference in the coefficients of digestibility of the dry substance was produced by differences in the amount of feed consumed from maintenance to full feed.

Summary.—In the first and second test periods the coefficients of digestibility of the dry substance varied inversely as the amounts of feed consumed. In the second period, however, the differences between the lots on the heavier rations were less distinct than those in the first test period. In the third test period the coefficient for the maintenance lot was again the highest, and the maintenance lot was the only lot that was at all distinct. In the fourth test period the digestibility of the dry substance seemed to be little affected by the amount of feed consumed.

Effect of Character of Ration Upon Effect Exerted by Amounts of Feed Consumed

From an examination of the data of the first, second, and third test periods, it seems that the lot differences in the coefficients of digestibility of the dry substance—that is, differences due to the differences in the amounts of feed consumed—resulted mainly, if not entirely, from the presence in the ration of comparatively large amounts of clover hay. This was indicated by the fact that when the quantity of clover hay was relatively large, as in the first test period, the differences between the coefficients of the four lots were marked, while as the relative amount of clover hay in the rations was reduced, the differences between the coefficients of the four lots decreased. As this decrease occurred in spite of the fact that at the same time that the proportion of clover hay was decreased, the proportion of ground corn in the ration was increased, the coefficient of digestibility of the dry substance of the corn either did not vary at all with the amount of feed consumed, or the variation was obscured by the greater variation in the digestibility of the dry substance of the clover hay.

Differences in the bulk of the rations alone did not produce the variations, as the amounts of feed consumed by the four lots during the second and third test periods were as widely different as those of the first test period, and the bulk of the rations during any one period varied directly as the amounts of feed. Moreover, tho the actual bulk or volume of the rations of the maintenance and one-third-feed lots in the first and second test periods was doubtless not as great as that of the rations of the two-thirds-feed and the full-feed lots in the third and fourth test periods, the differences between the coefficients of the lots in the former case were rather distinct, while in the latter case they were insignificant. Evidently, therefore, the differences in the coefficients resulting from the differences in the amounts of feed consumed were dependent on the character of the material consumed rather than on the volume or bulk of the ration.

Accordingly, from the results of this experiment it seems that the factor responsible for the differences in the digestibility of the rations due to differences in the amounts of feed consumed, was the relatively large amount of crude fiber in the ration. In the case of the carbohydrates it seems from these data and the results obtained by Eckels¹ that the presence of the large amount of crude fiber influenced only the digestibility of the nitrogen-free extract, and that its own digestibility was not changed.

The substitution of linseed oil meal for one part of the ground corn of the ration in the fourth test period further reduced the differences in the digestibility of the dry substance that were due to differences in the amount of feed consumed, and increased the digestibility of the dry substance, particularly in the case of the heavier rations.

¹Mo. Agr. Exp. Sta., Res. Bul. 4.

COEFFICIENTS OF DIGESTIBILITY OF CARBOHYDRATES

In Table 6 are given the coefficients of digestibility of the carbohydrates by periods. These data were computed from the weekly data given in Table 5, page 273 of the Appendix and represented graphically by Fig. 3 of the Appendix. The average coefficients are represented in Fig. 5.

The effects of the character of the ration and of the amounts of feed consumed upon the coefficients of digestibility of the carbohydrates were practically the same as those upon the coefficients of digestibility of the dry substance described above.

When the ration consisted of clover hay and ground corn in the ratio of 1:1, and varied from maintenance to full feed, the coefficients of digestibility of the carbohydrates varied inversely as the amounts of feed consumed. When the ratio of hay to corn was changed to 1:3, the relations of the coefficients remained essentially the same as they had been in the first test period, except that the difference between the values for the two animals in the full-feed lot was much increased, and hence, the two-thirds-feed lot and the full-feed lot were not essentially different. When the ratio of hay to corn was changed to 1:5, and also when linseed oil meal was substituted for one part of the ground corn, practically no differences in the coefficients were produced by differences in the amounts of feed consumed.

COEFFICIENTS OF DIGESTIBILITY OF CRUDE PROTEIN

The coefficients of digestibility of the crude protein are given in Table 7. The detailed weekly data are given in Table 6 of the Appendix, page 275, and are represented graphically by Figs. 4 and 5 also of the Appendix.

Effect of Character of Ration

The coefficients of digestibility of the crude protein, like those of the dry substance and carbohydrates, increased from the first to the third test period as the proportion of clover hay in the ration was decreased and the proportion of ground corn increased. In the fourth test period there was a still further increase, due to the greater digestibility of the protein of the linseed oil meal as compared with that of the ground corn.

TABLE 6.—COEFFICIENTS OF DIGESTIBILITY OF CARBOHYDRATES
(Results expressed in percent)

Period	Pre-lim- inary	Test	Aver- age	Transi- tional	Pre-lim- inary	Test	Aver- age	Transi- tional	Pre-lim- inary	Test	Aver- age	Transi- tional	Pre-lim- inary	Test	Aver- age
	1-2	3-5	1-5	6-7	8-9	10-13	8-13	14-16	17-18	19-22	17-22	23-24	25-26	27-30	25-30
Experimental weeks															
Ratio of hay to corn to oil meal	1:1:0	1:1:0	1:1:0	1:1:0:0	1:3:0	1:3:0	1:3:0	1:3:0:0	1:5:0	1:5:0	1:5:0	1:4:4:0.6	1:4:1	1:4:1	1:4:1
Maintenance	656	656	656	656	656	656	656	656	656	656	656	656	656	656	656
Steer 650	72.32	74.54	73.65	75.45	83.16	81.05	81.76	81.13	82.74	82.34	82.47	83.15	82.97	84.06	83.70
" " " " " "	72.34	75.17	74.04	78.79	83.59	82.71	83.01	83.20	82.64	82.78	82.74	82.10	80.34	82.01	81.46
Average	72.33	74.85	73.84	77.12	83.37	81.88	82.38	82.17	82.69	82.56	82.60	82.62	81.65	83.03	82.57
One-third feed.	669	669	669	669	669	669	669	669	669	669	669	669	669	669	669
Steer 666	72.85	72.70	72.76	71.90	77.25	76.17	76.53	77.07	78.38	78.84	78.69	81.27	80.75	81.27	81.10
" " " " " "	61.64	70.75	67.10	71.28	73.72	74.97	74.55	75.18	80.87	79.92	80.24	79.40	78.65	79.51	79.22
Average	67.24	71.72	69.93	71.59	75.48	75.57	75.54	76.12	79.62	79.38	79.46	80.34	79.70	80.39	80.16
Two-thirds feed.	665	665	665	665	665	665	665	665	665	665	665	665	665	665	665
Steer 652	65.95	70.57	68.72	72.21	72.98	73.14	73.08	76.42	81.46	79.63	80.24	81.32	80.78	80.86	80.84
" " " " " "	64.43	69.91	67.72	72.23	70.94	71.66	71.42	71.19	73.41	74.89	74.23	72.85	74.76	74.80	74.79
Average	65.19	70.24	68.22	72.21	71.96	72.40	72.25	73.80	77.43	77.25	77.31	77.08	77.77	77.83	77.81
Full feed.	661	661	661	661	661	661	661	661	661	661	661	661	661	661	661
Steer 663	65.90	68.80	67.64	68.31	72.87	74.34	73.85	74.38	76.34	78.09	77.51	78.51	81.19	82.72	82.21
" " " " " "	....	66.17	66.17	65.53	65.76	63.03	63.94	64.98	70.96	70.07	70.37	70.86	75.67	75.46	75.53
Average . . . . .	....	67.48	....	66.91	69.31	68.69	68.90	69.68	73.64	74.08	73.93	74.68	78.43	79.09	78.87
Grand average	67.92	71.08	69.72	71.96	75.03	74.63	74.77	75.44	78.35	78.32	78.31	78.68	79.39	80.09	79.86

TABLE 7.—COEFFICIENTS OF DIGESTIBILITY OF CRUDE PROTEIN (N x 6.25)
(Results expressed in percent.)

Period	Pre-limi- nary	Test	Aver- age	Transi- tional	Pre-limi- nary	Test	Aver- age	Transi- tional	Pre-limi- nary	Test	Aver- age	Transi- tional	Pre-limi- nary	Test	Aver- age
Experimental weeks	1-2	3-5	1-5	6-7	8-9	10-13	8-13	14-16	17-18	19-22	17-22	23-24	25-26	27-30	25-30
Ratio of hay to corn to oil meal	1:1:0	1:1:0	1:1:0	1:1:0	1:3:0	1:3:0	1:3:0	1:3:0	1:5:0	1:5:0	1:5:0	1:4:0.6	1:4:1	1:4:1	1:4:1
Maintenance	Steer 650	43.57	43.39	42.42	48.86	48.65	48.73	50.40	49.45	52.94	51.78	67.25	68.45	71.23	70.30
„	„ 656	47.41	50.31	50.29	54.09	50.21	51.50	50.22	50.50	52.53	51.85	64.42	67.78	69.44	68.89
Average . . . . .	.....	45.48	46.85	46.35	51.48	49.42	50.11	50.31	49.97	52.73	51.81	65.83	68.11	70.33	69.59
One-third feed	Steer 666	43.65	48.26	41.89	50.95	51.98	51.64	51.98	50.00	54.09	52.73	64.09	66.83	66.55	66.64
„	„ 669	45.42	44.13	48.93	51.06	54.83	53.58	54.96	53.93	55.20	54.78	61.17	64.82	68.91	67.55
Average . . . . .	.....	44.54	46.19	45.41	51.01	53.40	52.61	53.47	51.96	54.64	53.75	62.63	65.82	67.73	67.09
Two-thirds feed	Steer 652	42.55	41.61	45.06	47.77	48.94	48.55	49.57	46.31	50.65	49.41	62.61	64.46	67.80	66.69
„	„ 665	42.49	41.71	39.46	50.28	51.04	50.77	46.28	47.80	51.47	50.25	59.38	65.33	65.52	65.46
Average . . . . .	.....	42.52	41.66	42.26	49.02	49.99	49.67	47.92	47.35	51.06	49.82	60.99	64.89	66.66	66.07
Full feed	Steer 663	41.48	42.31	44.06	46.28	45.78	45.95	48.24	47.30	53.72	51.75	61.73	69.44	70.92	70.43
„	„ 661	39.43	....	36.17	39.58	43.69	42.32	42.20	46.17	48.47	47.71	60.39	64.91	65.52	65.32
Average . . . . .	.....	40.45	....	40.11	42.93	44.73	44.13	45.22	46.98	51.09	49.73	61.06	67.17	68.22	67.87
Grand average	45.63	43.25	44.53	43.53	48.61	49.39	49.13	49.23	40.07	52.38	51.28	62.63	66.50	68.24	67.66

Effect of Amounts of Feed Consumed

First Test Period.—The coefficients obtained for the four lots in the first test period were as follows: maintenance lot, 45.48; one-third-feed lot, 44.54; two-thirds-feed lot, 42.52; and full-feed lot, 40.45. The coefficients for the single animals were: in the maintenance lot, 43.57 and 47.41; in the one-third-feed lot, 43.65 and 45.42; in the two-thirds-feed lot, 42.55 and 42.49; and in the full-feed lot, 41.48 and 39.43. Except in the two-thirds-feed lot, the differences within the lots were so large that the differences between the lots were not significant. It seems worthy of note, however, that, in general, the coefficients for the individual animals of any one lot did not fall within the range of those of any other lot except in the case of the maintenance lot, one coefficient of which was lower than one, and practically the same as the other, coefficient of the one-third-feed lot.

From these facts it may be concluded that in the first test period, the amount of feed consumed exerted little, if any, influence upon the apparent coefficients of digestibility of the crude protein.

Second Test Period.—In the second test period the following average coefficients were obtained: maintenance lot, 49.42; one-third-feed lot, 53.40; two-thirds-feed lot, 49.99; and full-feed lot, 44.73. The last three values varied inversely as the amount of feed consumed. The coefficient of the maintenance lot was lower than that of the two-thirds-feed lot. The coefficients for the individual animals were as follows: in the maintenance lot, 48.65 and 50.21; in the one-third-feed lot, 51.98 and 54.83; in the two-thirds-feed lot, 48.94 and 51.04; and in the full-feed lot, 45.78 and 43.69. Those of the full-feed lot were fairly distinct. The coefficient of No. 665 of the two-thirds-feed lot was very near that of No. 666 of the one-third-feed lot. The values for the animals of the maintenance lot were not distinct from those for the animals in the two-thirds-feed lot. Accordingly, it seems that the amounts of feed consumed had little, if any, effect in the second test period upon the coefficients of digestibility of the crude protein.

Third Test Period.—In the third test period the following average coefficients were obtained for the different lots: maintenance lot, 52.73; one-third-feed lot, 54.64; two-thirds-feed lot, 51.06; and full-feed lot, 51.09. The values for the two-thirds and full-feed lots, therefore, were practically the same, while the value for the one-third-feed lot was the highest, and that for the maintenance lot, the next highest. The coefficients for the individual animals in the third period were: in the maintenance lot, 52.94 and 52.53; in the one-third-feed lot, 54.09 and 55.20; in the two-thirds-feed lot, 50.65 and 51.47; and in the full-feed lot, 53.72 and 48.47. From a comparison of these values it is evident that the full-feed lot was not essentially different from any of the other lots, and that there was not much difference between the maintenance, the one-third, and the two-thirds-feed lots. Accordingly,

in the third test period, no essential difference in the digestibility of the crude protein resulted from differences in the amounts of feed consumed.

Fourth Test Period.—The coefficients for the four lots in the last test period were as follows: maintenance lot, 70.33; one-third-feed lot, 67.73; two-thirds-feed lot, 66.66; and full-feed lot, 68.22. In this case, therefore, the coefficient of the maintenance lot was the highest, and was followed by those of the full-feed lot, the one-third-feed lot, and the two-thirds-feed lot in the order named. The coefficients for the individual animals of each lot were: in the maintenance lot, 71.23 and 69.44; in the one-third-feed lot, 66.55 and 68.91; in the two-thirds-feed lot, 67.80 and 65.52; and in the full-feed lot, 70.92 and 65.52. From these values it is evident that the differences within the lots were so great that the differences between the lots were not significant. Therefore, also in the fourth test period, the digestibility of the crude protein was not affected by the amounts of feed consumed.

Summary.—When the rations consisted of clover hay and ground corn in ratios varying from 1:1 to 1:5, or of clover hay, ground corn, and linseed oil meal in the ratio of 1:4:1, and varied in amount from maintenance to full feed, the amount of feed consumed seemed to exert little, if any, influence upon the coefficients of digestibility of the crude protein.

In the study of these data it will be noted that the metabolic nitrogen of the feces has been included with the undigested nitrogen. It is probable that the metabolic nitrogen may have had an appreciable influence on the relative positions of the lots, but there is no very definite evidence in the data to indicate that such was the case.

COEFFICIENTS OF DIGESTIBILITY OF FAT

The coefficients of digestibility of the fat by periods are given in Table 8. The weekly data from which these coefficients were derived are represented graphically by Figs. 4 and 5 of the Appendix, and are given in Table 7, page 277 of the Appendix.

Effect of Character of Ration

Like the coefficients for the dry substance, carbohydrates, and protein, the coefficients for the fat increased as the proportion of roughage in the ration was decreased and the proportion of concentrates increased. The marked rise in the graph (Fig. 5, Appendix) representing the average coefficient from the twenty-first to the twenty-fourth weeks was due largely to a very great increase in the coefficient of digestibility for Steer 661.

TABLE 8.—COEFFICIENTS OF DIGESTIBILITY OF CRUDE FAT (ETHER EXTRACT)
(Results expressed in percent)

Period		Pre-lim- nary	Test	Aver- age	Transi- tional	Pre-lim- nary	Test	Aver- age	Transi- tional	Pre-lim- nary	Test	Aver- age	Transi- tional	Pre-lim- nary	Test	Aver- age
Experimental weeks		1-2	3-5	1-5	6-7	8-9	10-13	8-13	14-16	17-18	19-22	17-22	23-24	25-26	27-30	1:4:1
Ratio of hay to corn to oil meal		1:1:0	1:1:0	1:1:0	1:1:0	1:3:0	1:3:0	1:3:0	1:3:0	1:5:0	1:5:0	1:5:0	1:4:4:0.6	1:4:1	1:4:1	1:4:1
Maintenance	Steer 650	72.67	73.19	72.98	76.27	77.81	80.00	79.27	83.86	85.03	86.69	86.14	87.82	85.37	83.38	84.05
"	" 656	76.15	73.97	74.84	75.36	75.97	77.95	77.29	82.62	88.00	85.71	86.48	84.56	84.98	85.38	85.25
Average	.....	74.41	73.58	73.91	75.81	76.89	78.97	78.28	83.24	86.51	86.20	86.30	86.19	85.17	84.38	84.65
One-third feed	Steer 666	81.85	76.14	78.42	79.35	79.10	80.41	79.98	84.78	87.56	86.59	86.92	87.17	86.69	84.36	85.14
"	" 669	72.82	72.26	72.49	78.76	79.46	80.09	79.88	82.68	85.30	82.72	83.58	81.65	83.14	81.41	81.99
Average	.....	77.33	74.20	75.45	79.05	79.28	80.25	79.93	83.73	86.43	84.65	85.24	84.41	84.91	82.88	83.56
Two-thirds feed	Steer 652	71.34	72.83	72.24	76.08	74.60	78.71	77.34	82.30	84.53	83.25	83.67	85.94	83.40	83.18	83.26
"	" 665	76.64	71.65	73.65	73.74	75.30	81.59	79.49	82.73	83.59	83.88	83.79	85.47	85.17	83.48	84.04
Average	.....	73.99	72.24	72.94	74.91	74.95	80.14	78.41	82.51	84.05	83.56	83.73	85.70	84.28	83.33	83.65
Full feed	Steer 652	73.27	73.19	73.22	68.49	73.42	67.72	69.62	71.25	83.01	82.11	82.41	85.89	85.48	84.29	84.69
"	" 661	....	64.63	....	61.42	54.73	64.12	60.99	54.21	34.08	44.65	41.13	73.70	83.96	76.91	79.26
Average	.....	....	68.91	....	64.95	64.07	65.92	65.30	62.73	58.54	63.38	61.77	79.79	84.72	80.60	81.97
Grand average	.....	74.96	72.23	73.98	73.68	73.80	76.32	75.48	78.05	78.89	79.45	79.26	84.02	84.77	82.80	83.46

Effect of Amounts of Feed Consumed

First Test Period.—The coefficients representing the lots in the first test period were as follows: maintenance lot, 73.58; one-third-feed lot, 74.20; two-thirds-feed lot, 72.24; and full-feed lot, 68.91. In the case of the one-third-feed, the two-thirds-feed, and the full-feed lots, the average coefficients varied inversely as the amount of feed consumed. The coefficient for the maintenance lot fell between that of the two-thirds-feed lot and that of the one-third-feed lot. The values for the individual animals were: in the maintenance lot, 73.19 and 73.97; in the one-third-feed lot, 76.14 and 72.26; in the two-thirds-feed lot, 72.83 and 71.65; and in the full-feed lot, 73.19 and 64.63. The difference between the coefficients for the two animals in the full-feed lot was large, the coefficient for No. 661 being much lower than any of the others in the four lots, and the coefficient for No. 663 being exceeded by only two others, one each in the one-third-feed and the maintenance lots. In view of these relations of the coefficients for the individual animals, it seems that in the first test period the amount of feed consumed was not an appreciable factor in determining the lot differences.

Second Test Period.—In the second test period, the coefficients by lots were: maintenance lot, 78.97; one-third-feed lot, 80.25; two-thirds-feed lot, 80.14; and full-feed lot, 65.92. The differences between the maintenance, the one-third-feed, and the two-thirds-feed lots were very slight—less than might have been produced by the difference in coefficients for the single animals in each lot. The average for the full-feed lot was much lower than any of the other lot averages, as both of its coefficients were low. The significance of this difference between the full-feed lot and the other lots is doubtful with respect to the amount of feed as a cause.

Third Test Period.—During the third test period, the coefficients of digestibility of the fat were as follows: maintenance lot, 86.20; one-third-feed lot, 84.65; two-thirds-feed lot, 83.56; and full-feed lot, 63.38. The coefficients for the maintenance, the one-third-feed, and the two-thirds-feed lots were practically the same in value, while the average for the full-feed lot was markedly lower. The coefficients for the individual animals within the lots were: in the maintenance lot, 86.69 and 85.71; in the one-third-feed lot, 86.59 and 82.72; in the two-thirds-feed lot, 83.25 and 83.88; and in the full-feed lot, 82.11 and 44.65. The difference between the full-feed lot and the others was due entirely to the fact that the value for Animal 661 was very low, and the coefficient for Animal 663 not any higher than the values in the other lots. From all of these data, therefore, it seems that the variation in the amounts of feed was not the cause of the lot differences.

Fourth Test Period.—The lot coefficients in the fourth test period were: maintenance lot, 84.38; one-third-feed lot, 82.88; two-thirds-feed lot, 83.33; and full-feed lot, 80.60. The coefficients for the individual animals were: in the maintenance lot, 83.38 and 85.38; in the one-third-feed lot, 84.36 and 81.41; in the two-thirds-feed lot, 83.18 and 83.48; and in the full-feed lot, 84.29 and 76.91. Accordingly, in the fourth test period there was little difference between the lots, and the amount of feed consumed exerted practically no effect upon the digestibility of the fat when the ration consisted of clover hay, ground corn, and linseed oil meal in the ratio of 1:4:1, and varied from maintenance to full feed.

Summary.—There was little evidence that the coefficients of digestibility of the fat were very greatly influenced by the amount of feed consumed. While during the major part of the experiment the values obtained for the full-feed animals were appreciably lower than those obtained for the other lots, the great irregularity of the variations detracts from their significance with respect to the effect of the amounts of feed consumed. Moreover, the fluctuations were not very closely correlated with the variations in the consumption of fat or the variations in the consumption of feed.

SUGGESTIONS IN REGARD TO METHODS OF CONDUCTING DIGESTION EXPERIMENTS

In studying the data obtained in this experiment it will be noted that any marked change in the conditions under which the animals were kept resulted in more or less marked fluctuations in the coefficients of digestibility of one or more of the nutrients. Thus, there was a fluctuation in the first preliminary period when the steers were becoming accustomed to the conditions under which the experiment was conducted, and also during, or immediately following, every transitional period in which a change was made in the character of the ration. Usually these fluctuations subsided at the end of a week, but in some cases they could be noted during the second subsequent week. From these facts, therefore, it is evident that whenever in a digestion experiment a change is made in the conditions of the experiment, the transitional period should be followed by a preliminary period two weeks in length before the test period is begun, and that the ration fed in the preliminary period should be uniform in amount and character with that fed in the test period.

There will also be noted in a study of the data of this experiment a considerable fluctuation in the coefficients from week to week which was not confined to any particular period, nutrient, or animal. The variation in successive weeks of the test period at times was as great as 3 to 8 percent. From the data at hand its cause is rather difficult to determine. It may have been the result of variations in the amounts

of the feeds digested, due to variations in the nature and amounts of the digestive juices secreted, and possibly also to other factors, such as differences in the rate or completeness of absorption. It is most probable, however, that it was caused largely by irregularities in the time that elapsed between the ingestion of the feed and the appearance of the resulting feces. If the feces were formed and voided rather rapidly at the beginning of the week and slowly at the end of the week, it is probable that the coefficients were too high to represent the actual amounts of nutrients digested. On the other hand, if the feces were formed and voided slowly at the beginning of the week and rapidly at the end, the coefficients were probably too low to represent the actual digestibility. In the first case less of the undigested residue from the feed of the previous week would have been found in the feces for the test week than would have been carried over from the test week to the week following. As a result, the amount of undigested residue in the feces voided during the week would have been smaller than the amount derived from the feed for that week. In the second case the reverse would have been true. From these facts it is quite evident that the coefficients for any given week may not be representative of the digestibility of a nutrient over an extended period of time, and that if the significance of the results obtained in a digestion experiment are to be increased, the test periods must be extended over a period three or four weeks in length.

The variations in the coefficients for individual animals also are of importance in this connection. In three out of four cases the individuals of any one lot furnished very good duplicates, the variation being comparatively small. In the full-feed lot, however, the two individual values were widely different. There is not sufficient data to indicate definitely whether this is more likely to occur in the case of animals on full feed or not. Only a small part of the difference found in the full-feed lot can be accounted for by the differences in the amounts of feed consumed. The difference between the amounts of feed consumed by these steers was less than that between the amounts consumed by the full-feed and the two-thirds-feed lots, but the difference in coefficients was much greater. It does seem evident, however, that in order to get representative coefficients, it is necessary to use more than one animal in any trial. In case the coefficients obtained with the various animals do not agree fairly well, further trials should be made with other animals to check the results.

It is quite obvious that when the amount of roughage in the ration is comparatively large, the coefficients of digestibility obtained on a maintenance ration are not applicable to a full-feed ration.

SUMMARY

PLAN OF EXPERIMENT

1. Eight two-year-old, choice feeder steers were divided into four lots of two steers each. One lot was given a ration slightly above maintenance; another, an amount of feed equal to the maintenance ration plus one-third of the difference between the maintenance and the full-feed rations; another, an amount equal to the maintenance ration plus two-thirds of the difference between the maintenance and the full-feed rations; and another, as much feed as the steers would eat readily.

2. The experiment lasted for 30 weeks and was divided into four general divisions each of which consisted of a transitional, a preliminary, and a test period. The first and third transitional periods were two weeks in length, and the second, three weeks in length. Each of the preliminary periods lasted for two weeks. The first test period was three weeks in length, and the second, third, and fourth, each four weeks in length.

3. The feeds used were clover hay, ground corn, and linseed oil meal. The ration of the first test period consisted of clover hay and ground corn in the ratio of 1:1; that of the second, of clover hay and ground corn in the ratio of 1:3; that of the third, of clover hay and ground corn in the ratio of 1:5; and that of the fourth, of clover hay, ground corn, and linseed oil meal in the ratio of 1:4:1.

EFFECT OF CHARACTER OF RATION

4. In the first test period, when the ration consisted of clover hay and ground corn in the ratio of 1:1, the coefficients of digestibility of the dry substance for the individual animals varied from 61.55 to 70.69; in the second test period, when the ration consisted of clover hay and ground corn in the ratio of 1:3, they varied from 59.49 to 78.22; in the third test period, when the ration consisted of clover hay and ground corn in the ratio of 1:5, they varied from 65.42 to 79.08; and in the fourth test period when the ration consisted of clover hay, ground corn, and linseed oil meal in the ratio of 1:4:1, they varied from 72.40 to 80.64. For the eight steers together the average coefficients of digestibility for the dry substance for the four test periods were: first test period, 66.44; second test period, 70.74; third test period, 74.57; and fourth test period, 77.09.

5. The coefficients of digestibility of the carbohydrates for the individual animals varied, in the first test period, from 66.17 to 75.17. In the second test period they varied from 63.03 to 82.71; in the third test period, from 70.07 to 82.78; and in the fourth test period, from 74.80 to 84.06. For the eight steers together the average coefficients

of digestibility of the carbohydrates for the four periods were: first test period, 71.08; second test period, 74.63; third test period, 78.32; and fourth test period, 80.09.

6. The coefficients of digestibility of the crude protein for the individual animals varied from 39.43 to 47.41 in the first test period; from 43.69 to 54.83 in the second test period; from 48.47 to 55.20 in the third test period; and from 65.52 to 71.23 in the fourth test period. For the eight steers together the average coefficients of digestibility for the crude protein for the four test periods were: first test period, 43.25; second test period, 49.39; third test period, 52.38; and fourth test period, 68.24.

7. The coefficients of digestibility of the fat for the individual animals varied as follows: in the first test period, from 64.63 to 76.14; in the second test period, from 64.12 to 81.59; in the third test period, from 44.65 to 86.69; and in the fourth test period, from 76.19 to 85.38. For the eight steers together the average coefficients of digestibility for the fat for the four test periods were: first test period, 72.23; second test period, 76.32; third test period, 79.45; and fourth test period, 82.80.

EFFECT OF AMOUNTS OF FEED CONSUMED

8. The average coefficients of digestibility of the dry substance for the four lots of animals were: in the first test period—maintenance lot, 69.99; one-third-feed lot, 67.11; two-thirds-feed lot, 65.62; and full-feed lot, 63.03; in the second test period—maintenance lot, 77.28; one-third-feed lot, 72.06; two-thirds-feed lot, 69.07; and full-feed lot, 64.56; in the third test period—maintenance lot, 78.79; one-third-feed lot, 75.74; two-thirds-feed lot, 73.62; and full-feed lot, 70.11; and in the fourth test period—maintenance lot, 79.99; one-third-feed lot, 74.14; two-thirds-feed lot, 75.10; and full-feed lot, 76.12.

9. The average coefficients of digestibility of the carbohydrates for the four lots of animals were: in the first test period—maintenance lot, 74.85; one-third-feed lot, 71.72; two-thirds-feed lot, 70.24; and full-feed lot, 67.48; in the second test period—maintenance lot, 81.88; one-third-feed lot, 75.57; two-thirds-feed lot, 72.40; and full-feed lot, 68.69; in the third test period—maintenance lot, 82.56; one-third-feed lot, 79.38; two-thirds-feed lot, 77.25; and full-feed lot, 74.08; and in the fourth test period—maintenance lot, 83.03; one-third-feed lot, 80.39; two-thirds-feed lot, 77.83; and full-feed lot, 79.09.

10. The average coefficients of digestibility for the crude protein for the four lots of animals were: in the first test period—maintenance lot, 45.48; one-third-feed lot, 44.54; two-thirds-feed lot, 42.52; and full-feed lot, 40.45; in the second test period—maintenance lot, 49.42; one-third-feed lot, 53.40; two-thirds-feed lot, 49.99; and full-

feed lot, 44.73; in the third test period—maintenance lot, 52.73; one-third-feed lot, 54.64; two-thirds-feed lot, 51.06; and full-feed lot, 51.09; and in the fourth test period—maintenance lot, 70.33; one-third-feed lot, 67.73; two-thirds-feed lot, 66.66; and full-feed lot, 68.22.

11. The average coefficients of digestibility for the fat for the four lots of animals were: in the first test period—maintenance lot, 73.58; one-third-feed lot, 74.20; two-thirds-feed lot, 72.24; and full-feed lot, 68.91; in the second test period—maintenance lot, 78.79; one-third-feed lot, 80.25; two-thirds-feed lot, 80.14; and full-feed lot, 65.92; in the third test period—maintenance lot, 86.20; one-third-feed lot, 84.65; two-thirds-feed lot, 83.56; and full-feed lot, 63.38; and in the fourth test period—maintenance lot, 84.38; one-third-feed lot, 82.88; two-thirds-feed lot, 83.33; and full-feed lot, 80.60.

CONCLUSIONS

EFFECT OF CHARACTER OF RATION

1. The coefficients of digestibility of the dry substance, the carbohydrates, the proteins, and the fat of a ration of clover hay and ground corn increase as the ratio of clover hay to ground corn is varied from 1:1 to 1:5.

2. The coefficients of the dry substance, the carbohydrates, the proteins, and the fat of a ration of clover hay, ground corn, and linseed oil meal in the ratio of 1:4:1 are greater than the digestibility of the same nutrients of rations composed of clover and ground corn in the ratio of 1:1, 1:3, or 1:5. The replacing of one part of ground corn in a ration of clover hay and ground corn in the ratio of 1:5 by one part of linseed oil meal to form a ration of clover hay, ground corn, and oil meal in the ratio of 1:4:1, causes a moderate increase in the coefficients of digestibility of the dry substance, the carbohydrates, and the fat, and a very decided increase in the coefficients of the crude protein.

EFFECT OF AMOUNTS OF FEED CONSUMED

3. The coefficients of digestibility of the dry substance and carbohydrates of a ration composed of clover hay and ground corn in the ratio of 1:1 vary inversely as the amounts of feed consumed when the latter vary from maintenance to full feed.

4. The coefficients of digestibility of the dry substance and the carbohydrates of a ration of clover hay and ground corn in the ratio of 1:3 or 1:5 may be greater in the maintenance ration than in the one-third-feed ration, the two-thirds-feed ration, or the full-feed ration. Between the coefficients of digestibility of the dry substance of rations heavier than maintenance or one-third feed, there is little, if any, difference.

5. The coefficients of digestibility of the protein and the fat of rations composed of clover hay and ground corn in the ratio of 1:1, 1:3, or 1:5, apparently do not vary with the amounts of feed.

6. The coefficients of digestibility of none of the nutrients of a ration of clover hay, ground corn, and oil meal in the ratio of 1:4:1 are affected by the amounts of feed consumed.

7. The cause of the differences in digestibility induced by differences in the amounts of feed consumed seems to be the proportion of hay in the ration. Apparently, the essential point of difference caused by the larger proportion of hay is in the content of crude fiber. Hence, it may be said that differences in the amounts of feed consumed influence the digestibility only when the quantity of crude fiber in the ration is relatively large.

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APPENDIX

	PAGE
TABLE 1.—Total Feed and Nutrients Offered and Consumed During the Test Periods	265
TABLE 2.—Total Feces and Total Nutrients Voided in the Feces During the Test Periods	269
TABLE 3.—Total Nutrients Digested During the Test Periods.....	270
TABLE 4.—Coefficients of Digestibility of Dry Substance.....	271
TABLE 5.—Coefficients of Digestibility of Carbohydrates.....	273
TABLE 6.—Coefficients of Digestibility of Crude Protein ($N \times 6.25$).....	275
TABLE 7.—Coefficients of Digestibility of Crude Fat (Ether Extract).....	277
FIG. 1a.—Rear of Stalls.....	279
FIG. 1b.—Rear of Stalls.....	280
FIG. 1c.—Front of Stalls.....	281
FIG. 2.—Sampling the Feces.....	282
FIG. 3.—Curves for Coefficients of Digestibility of Dry Substance and Carbohydrates	283
FIG. 4.—Curves for Coefficients of Digestibility of Crude Protein and Fat..	284
FIG. 5.—Curves for Average Coefficients of Digestibility of the Various Nutrients	285

TABLE 1.—TOTAL FEED AND NUTRIENTS OFFERED AND CONSUMED DURING THE TEST PERIODS¹

(Results expressed in pounds)

Test period	Experimental weeks	Feed	Amount of feed	Dry substance	Carbohydrates	Protein (N x 6.25)	Crude fat	Ash
Maintenance—Animal 650								
1	3-5	Clover hay	115.64	91.248	69.940	12.802	2.395	6.107
		Ground corn	115.64	91.332	78.232	7.927	3.811	1.357
		Total offered	231.28	182.580	148.172	20.729	6.206	7.464
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	231.28	182.580	148.172	20.729	6.206	7.464
2	10-13	Clover hay	63.84	56.648	44.264	7.173	1.528	3.761
		Ground corn	191.52	165.793	142.146	14.281	7.046	2.292
		Total offered	255.36	222.441	186.410	21.454	8.574	6.053
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	255.36	222.441	186.410	21.454	8.574	6.053
3	19-22	Clover hay	39.20	35.488	28.351	4.157	0.975	2.004
		Ground corn	196.00	172.153	145.997	15.223	8.414	2.545
		Total offered	235.20	207.641	174.348	19.380	9.389	4.549
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	235.20	207.641	174.348	19.380	9.389	4.549
4	27-30	Clover hay	38.64	33.682	26.919	3.868	0.859	2.034
		Ground corn	154.56	134.436	113.623	12.982	5.875	1.962
		Oil meal	38.64	35.138	16.801	13.873	2.577	2.139
		Total offered	231.84	203.256	157.343	30.713	9.311	6.135
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	231.84	203.256	157.343	30.713	9.311	6.135

Maintenance—Animal 656

1	3-5	Clover hay	115.64	100.912	77.513	14.050	2.641	6.075
		Ground corn	115.64	100.935	86.453	8.776	4.200	1.502
		Total offered	231.28	201.847	163.966	22.826	6.841	8.207
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	231.28	201.847	163.966	22.826	6.841	8.207
2	10-13	Clover hay	63.84	56.648	44.264	7.173	1.528	3.761
		Ground corn	191.52	165.793	142.146	14.281	7.076	2.292
		Total offered	255.36	222.441	186.410	21.454	8.604	6.053
		Orts	0.61	0.484	0.418	0.046	0.007	0.013
		Total consumed ..	254.75	221.957	185.992	21.408	8.597	6.040
3	19-22	Clover hay	39.20	35.448	28.351	4.157	0.975	2.004
		Ground corn	196.00	172.153	145.977	15.222	8.414	2.545
		Total offered	235.20	207.641	174.348	19.379	9.389	4.549
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	235.20	207.641	174.348	19.379	9.389	4.549
4	27-30	Clover hay	38.64	33.682	26.919	3.868	0.859	2.033
		Ground corn	154.56	134.435	113.623	12.974	5.875	1.962
		Oil meal	38.64	35.138	16.801	13.603	2.577	2.139
		Total offered	231.84	203.255	157.343	30.445	9.311	6.134
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	231.84	203.255	157.343	30.445	9.311	6.134

¹ The first test period was three weeks in length; the second, third, and fourth, each four weeks in length.

TABLE 1.—TOTAL FEED AND NUTRIENTS OFFERED AND CONSUMED DURING THE TEST PERIODS¹ (Continued)

(Results expressed in pounds)

Test period	Experimental weeks	Feed	Amount of feed	Dry substance	Carbohydrates	Protein (N x 6.25)	Crude fat	Ash
One-Third Feed—Animal 666								
1	3-5	Clover hay	163.31	128.747	98.720	18.038	3.378	8.608
		Ground corn	163.31	128.848	110.368	11.188	5.373	1.914
		Total offered	326.62	257.595	209.088	29.226	8.751	10.522
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	326.62	257.595	209.088	29.226	8.751	10.522
2	10-13	Clover hay	103.80	88.796	69.407	11.229	2.398	5.889
		Ground corn	311.40	259.876	222.792	22.389	11.104	3.594
		Total offered	415.20	348.672	292.199	33.618	13.502	9.483
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	415.20	348.672	292.199	33.618	13.502	9.483
3	19-22	Clover hay	58.52	52.985	42.299	6.212	1.458	2.996
		Ground corn	292.60	256.967	217.910	22.736	12.560	3.802
		Total offered	351.12	309.952	260.209	28.948	14.018	6.798
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	351.12	309.952	260.209	28.948	14.018	6.798
4	27-30	Clover hay	56.00	47.041	37.625	5.381	1.198	2.836
		Ground corn	224.00	187.826	158.740	18.116	8.220	2.747
		Oil meal	56.00	49.100	23.510	18.977	3.604	2.988
		Total offered	336.00	283.967	219.875	42.474	13.022	8.571
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	336.00	283.967	219.875	42.474	13.022	8.571

One-Third Feed—Animal 669

1	3-5	Clover hay	167.69	146.344	112.446	20.353	3.829	9.714
		Ground corn	167.69	146.363	125.361	12.731	6.089	2.177
		Total offered	335.38	292.707	237.807	33.084	9.918	11.891
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	335.38	292.707	237.807	33.084	9.918	11.891
2	10-13	Clover hay	108.24	96.050	75.043	12.167	2.591	6.380
		Ground corn	324.72	281.110	241.013	24.209	12.002	3.888
		Total offered	332.96	377.160	316.058	36.376	14.593	10.268
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	332.96	377.160	316.058	36.376	14.593	10.268
3	19-22	Clover hay	63.00	57.041	45.560	6.687	1.570	3.225
		Ground corn	315.00	276.641	234.596	24.477	13.522	4.092
		Total offered	378.00	333.682	280.156	31.164	15.092	7.317
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	378.00	333.682	280.156	31.164	15.092	7.317
4	27-30	Clover hay	60.48	53.217	42.136	6.052	1.343	3.182
		Ground corn	241.92	210.418	177.836	20.316	9.196	3.071
		Oil meal	60.48	55.000	26.309	21.282	4.032	3.348
		Total offered	362.88	318.635	246.281	47.650	14.571	9.601
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	362.88	318.635	246.281	47.650	14.571	9.601

¹The first test period was three weeks in length; the second, third, and fourth, each four weeks in length.

TABLE 1.—TOTAL FEED AND NUTRIENTS OFFERED AND CONSUMED DURING THE TEST PERIODS¹ (Continued)

(Results expressed in pounds)

Test period	Experimental weeks	Feed	Amount of feed	Dry substance	Carbohydrates	Protein (N x 6.25)	Crude fat	Ash
Two-Thirds Feed—Animal 652								
1	3-5	Clover hay	211.33	184.433	141.724	25.641	4.824	12.239
		Ground corn	211.33	184.452	157.984	16.044	7.671	2.744
		Total offered	422.66	368.885	299.708	41.685	12.495	14.983
		Orts.	0.47	0.378	0.301	0.048	0.010	0.019
		Total consumed ..	422.19	368.507	299.407	41.637	12.485	14.964
2	10-13	Clover hay	142.88	126.785	97.064	16.057	3.420	8.420
		Ground corn	428.64	371.068	318.142	31.959	15.840	5.132
		Total offered	571.52	497.853	415.205	48.016	19.260	13.552
		Orts.	0.30	0.793	0.066	0.008	0.002	0.002
		Total consumed ..	571.22	497.060	415.140	48.008	19.258	13.550
3	19-22	Clover hay	78.68	71.244	56.891	8.357	1.963	4.033
		Ground corn	393.40	340.461	292.936	30.581	16.886	5.111
		Total offered	472.08	411.705	349.827	38.938	18.849	9.144
		Orts. ....	.....	.....	.....	.....	.....	.....
		Total consumed ..	472.08	411.705	349.827	38.938	18.849	9.144
4	27-30	Clover hay	73.36	61.700	49.303	7.048	1.570	3.716
		Ground corn	293.44	246.112	208.003	23.746	10.770	3.599
		Oil meal	73.36	64.336	30.814	24.858	4.721	3.915
		Total offered	440.16	372.148	288.120	55.652	17.061	11.230
		Orts. ....	.....	.....	.....	.....	.....	.....
		Total consumed ..	440.16	372.148	288.120	55.652	17.061	11.230

Two-Thirds Feed—Animal 665

1	3-5	Clover hay	219.85	191.871	147.449	26.669	5.018	12.730
		Ground corn	219.85	191.888	164.351	16.692	7.982	2.885
		Total offered	439.70	383.759	311.800	43.361	13.000	15.585
		Orts.	0.21	0.074	0.056	0.010	0.002	0.005
		Total consumed ..	439.49	383.685	311.744	43.351	12.998	15.580
2	10-13	Clover hay	153.28	136.023	106.267	17.232	3.671	9.037
		Ground corn	459.84	398.089	341.307	34.276	17.000	5.506
		Total offered	613.12	534.112	447.574	51.508	20.671	14.543
		Orts. ....	.....	.....	.....	.....	.....	.....
		Total consumed ..	613.12	534.112	447.574	51.508	20.671	14.543
3	19-22	Clover hay	87.64	79.347	63.372	9.309	2.185	4.491
		Ground corn	438.20	384.810	326.307	34.059	18.810	5.694
		Total offered	525.84	464.157	389.679	43.368	20.995	10.185
		Orts. ....	.....	.....	.....	.....	.....	.....
		Total consumed ..	525.84	464.157	389.679	43.368	20.995	10.185
4	27-30	Clover hay	82.32	71.801	57.352	8.237	1.830	4.333
		Ground corn	329.28	286.402	242.048	27.656	12.516	4.179
		Oil meal	82.32	74.861	35.815	28.961	5.487	4.556
		Total offered	493.92	433.064	335.215	64.854	19.833	13.068
		Orts. ....	.....	.....	.....	.....	.....	.....
		Total consumed ..	493.92	433.064	335.215	64.854	19.833	13.068

¹The first period was three weeks in length; the second, third, and fourth, each four weeks in length.

TABLE 1.—TOTAL FEED AND NUTRIENTS OFFERED AND CONSUMED DURING THE TEST PERIODS¹ (Continued)

(Results expressed in pounds)

Test period	Experi- mental weeks	Feed	Amount of feed	Dry sub- stance	Car- bohy- drates	Pro- tein (N x 6.25)	Crude fat	Ash
Full Feed—Animal 663								
1	3-5	Clover hay	259.14	226.167	173.817	31.429	5.916	15.000
		Ground corn	259.14	226.179	193.725	19.576	9.403	3.365
		Total offered	518.28	452.346	367.542	51.005	15.319	18.365
		Orts	26.40	20.977	16.962	2.423	0.426	1.166
		Total consumed ..	491.88	431.369	350.580	48.582	14.893	17.199
2	10-13	Clover hay	182.84	162.245	126.768	20.551	4.377	10.775
		Ground corn	548.52	474.848	407.121	40.895	20.272	6.567
		Total offered	731.36	637.093	533.889	61.446	24.649	17.342
		Orts	105.84	90.786	75.914	8.612	3.665	2.581
		Total consumed ..	625.52	546.307	457.975	52.834	20.984	14.761
3	19-22	Clover hay	98.00	88.742	70.860	9.572	2.446	5.025
		Ground corn	490.00	430.275	364.849	38.094	21.002	6.369
		Total offered	588.00	519.017	435.709	47.666	23.448	11.394
		Orts	64.92	56.243	47.053	5.328	2.697	1.166
		Total consumed ..	523.08	462.774	388.656	42.338	20.751	10.228
4	27-30	Clover hay	90.72	79.072	63.205	9.075	2.016	4.774
		Ground corn.....	362.88	315.625	266.741	30.482	13.793	4.607
		Oil meal	90.72	82.501	39.477	31.912	6.049	5.022
		Total offered	544.32	477.198	369.423	71.469	21.858	14.403
		Orts	69.47	60.433	46.169	9.620	2.807	1.832
		Total consumed ..	474.85	416.765	323.254	61.849	19.051	12.571
Full Feed—Animal 661								
1	3-5	Clover hay	271.06	224.967	172.634	31.439	5.910	14.994
		Ground corn	271.06	225.064	192.819	19.552	9.342	3.346
		Total offered	542.12	450.031	365.453	50.991	15.252	18.340
		Orts	3.82	2.819	2.301	0.328	0.050	0.141
		Total consumed ..	538.30	447.212	363.152	50.663	15.202	18.199
2	10-13	Clover hay	197.68	175.425	137.046	22.225	4.735	11.655
		Ground corn	593.04	513.406	440.175	44.213	21.926	7.102
		Total offered	790.72	688.831	577.221	66.438	26.661	18.757
		Orts	20.89	16.282	13.629	1.620	0.607	0.425
		Total consumed ..	769.83	672.549	563.592	64.818	26.054	18.332
3	19-22	Clover hay	111.44	100.909	80.580	11.838	2.780	5.711
		Ground corn	557.20	489.299	414.904	43.312	23.888	7.241
		Total offered	668.64	590.208	495.484	55.150	26.668	12.752
		Orts	85.79	74.792	62.354	7.559	3.219	1.658
		Total consumed ..	582.85	515.416	433.130	47.591	23.449	11.294
4	27-30	Clover hay	104.16	87.531	69.911	10.083	2.241	5.294
		Ground corn	416.64	349.375	295.323	33.694	15.260	5.094
		Oil meal	104.16	91.310	43.587	35.418	6.699	5.560
		Total offered	624.96	528.216	408.821	79.195	24.200	15.948
		Orts .....	.....	.....	.....	.....	.....	.....
		Total consumed ..	624.96	528.216	408.821	79.195	24.200	15.948

¹The first test period was three weeks in length; the second, third, and fourth, each four weeks in length.

TABLE 2.—TOTAL FECES AND TOTAL NUTRIENTS VOIDED IN THE FECES DURING THE TEST PERIODS¹

(Results expressed in pounds)

Lot	Animal	Experimental weeks	Total feces	Dry substance	Total carbohydrate	Protein (N x 6.25)	Crude fat	Ash
Maintenance	650	3-5	388.38	56.255	37.927	11.646	1.676	5.001
		10-13	313.28	52.625	35.329	11.013	1.721	4.561
		19-22	224.09	44.630	30.778	9.115	1.249	3.485
		27-30	190.20	39.342	25.075	8.734	1.549	3.982
	656	3-5	368.15	59.139	40.629	12.003	1.787	4.718
		10-13	314.06	48.334	32.155	10.658	1.888	3.629
		19-22	245.55	43.415	29.992	9.209	1.339	2.871
		27-30	241.90	41.922	28.270	9.271	1.359	3.023
	666	3-5	538.17	82.693	57.151	16.387	2.101	7.076
		10-13	548.05	96.130	69.442	16.153	2.656	7.938
		19-22	359.90	76.705	56.034	13.283	1.879	5.525
		27-30	341.30	63.441	41.372	14.268	2.047	5.746
One-third feed	669	3-5	722.18	98.691	69.451	17.997	2.749	8.775
		10-13	605.36	106.573	79.129	16.423	2.914	8.104
		19-22	430.09	79.343	56.233	13.950	2.600	6.554
		27-30	379.87	74.700	50.427	14.787	2.706	6.783
	652	3-5	914.14	125.738	87.952	23.899	3.404	10.474
		10-13	889.81	151.248	111.430	24.507	4.102	11.206
		19-22	542.49	100.604	71.320	19.240	3.170	6.805
		27-30	520.87	82.806	55.277	17.925	2.894	6.712
	665	3-5	901.96	132.827	93.872	24.829	3.691	10.423
		10-13	899.17	167.836	126.900	25.198	3.801	11.930
		19-22	672.05	131.287	97.675	20.973	3.374	9.269
		27-30	590.27	119.506	84.503	22.332	3.284	9.388
Full feed	663	3-5	1052.49	153.138	109.348	28.373	3.994	11.418
		10-13	919.57	165.613	117.515	28.494	6.717	12.849
		19-22	597.92	116.609	85.388	19.958	3.717	7.643
		27-30	470.59	84.969	55.853	17.740	2.912	8.460
	661	3-5	1233.42	172.027	122.887	30.375	5.401	13.346
		10-13	1512.09	272.388	208.277	36.487	9.779	17.835
		19-22	861.26	178.698	130.057	24.465	13.038	11.129
		27-30	749.23	143.792	100.049	27.249	5.623	10.867

¹The first test period was three weeks in length; the second, third, and fourth, each four weeks in length.

TABLE 3.—TOTAL NUTRIENTS DIGESTED DURING THE TEST PERIODS¹
(Results expressed in pounds)

Lot	Animal	Experimental weeks	Dry substance	Carbohydrates	Protein (N x 6.25)	Crude fat
Maintenance.	650	3-5	126.325	110.246	9.083	4.531
		10-13	169.818	151.081	10.441	6.885
		19-22	163.011	143.570	10.265	8.142
		27-30	163.915	132.270	21.711	7.762
	656	3-5	142.708	123.339	10.823	5.053
		10-13	173.623	153.837	10.750	6.709
		19-22	164.226	144.356	10.170	8.050
		27-30	161.343	129.074	21.175	7.953
	666	3-5	174.902	151.937	12.839	6.650
		10-13	252.541	222.756	17.465	10.846
		19-22	233.247	205.195	15.665	12.140
		27-30	220.526	178.503	28.206	10.975
One-third feed	669	3-5	194.016	168.356	15.087	7.169
		10-13	270.587	236.929	19.954	11.679
		19-22	254.339	223.922	17.213	12.492
		27-30	243.435	195.854	32.864	11.865
	652	3-5	242.769	211.455	17.738	9.081
		10-13	345.812	303.710	23.499	15.156
		19-22	311.101	278.507	19.698	15.679
		27-30	289.289	232.844	37.726	14.167
	665	3-5	250.858	217.873	18.522	9.307
		10-13	366.276	320.674	26.310	16.870
		19-22	332.866	292.004	22.395	17.621
		27-30	313.558	250.713	42.522	16.549
Full feed	663	3-5	278.231	241.232	20.309	10.899
		10-13	380.694	340.460	24.340	14.267
		19-22	346.165	304.269	23.221	17.064
		27-30	331.796	267.401	44.110	16.139
	661	3-5	275.185	240.265	20.288	9.801
		10-13	400.161	355.315	28.332	17.275
		19-22	336.718	303.074	23.125	10.411
		27-30	384.425	308.772	51.947	18.576

¹The first test period was three weeks in length; the second, third, and fourth, each four weeks in length. No correction was applied for metabolic products in the feces.

TABLE 4.—COEFFICIENTS OF DIGESTIBILITY OF DRY SUBSTANCE
(Results expressed in percent)

Period	Experi- mental weeks	Ratio of hay to corn to oil meal	Maintenance			One-third feed			Two-thirds feed			Full feed			Aver- age of all
			650	656	Aver- age	666	669	Aver- age	652	665	Aver- age	663	661	Aver- age	
Preliminary	1	1:1:0	68.10	69.46	68.78	76.34	62.01	69.17	61.39	59.17	60.28	60.91	....	....	....
"	2	1:1:0	66.79	78.56	67.67	63.44	54.68	59.06	61.70	62.43	62.06	63.34	....	....	....
Average	1-2	1:1:0	67.44	69.01	68.22	69.89	58.34	64.11	61.54	60.80	61.17	62.12	....	....	....
Test	3	1:1:0	66.67	67.02	66.84	67.20	64.39	65.79	63.35	66.50	64.92	63.81	58.99	61.40	64.74
"	4	1:1:0	70.23	72.64	71.43	68.85	66.70	67.77	67.96	65.51	66.73	65.07	62.92	63.99	67.48
"	5	1:1:0	71.01	72.42	71.71	67.89	67.68	67.78	66.24	64.20	65.22	64.63	62.75	63.69	67.10
Average	3-5	1:1:0	69.30	70.69	69.99	67.98	66.26	67.11	65.85	65.40	65.62	64.50	61.55	63.03	66.44
Average	1-5	1:1:0	68.56	70.02	69.29	78.74	63.09	65.91	64.13	63.56	63.84	63.55	....	....	....
Transitional	6	1:1.5:0	69.53	72.12	70.82	67.58	67.90	67.74	68.28	66.75	67.51	64.67	62.50	63.58	67.42
"	7	1:2.5:0	72.78	76.26	74.52	66.99	67.21	67.10	67.44	67.50	67.47	64.83	59.16	61.99	67.77
Average	6-7	1:1.9:0	71.15	74.19	72.67	67.28	67.55	67.42	67.86	67.12	67.49	64.75	60.83	62.78	67.59
Preliminary	8	1:3:0	77.24	78.65	77.94	72.87	68.85	70.86	69.46	66.32	67.89	67.16	61.91	64.53	70.31
"	9	1:3:0	78.89	79.77	79.33	73.25	71.11	72.18	68.54	68.98	68.76	70.16	60.48	65.32	71.40
Average	8-9	1:3:0	78.06	79.21	78.63	73.06	69.98	71.52	69.00	67.65	68.32	68.66	61.19	64.92	70.85
Test	10	1:3:0	75.73	78.21	76.97	74.45	72.30	73.37	68.46	68.11	68.28	69.94	60.96	65.45	71.02
"	11	1:3:0	74.82	78.42	76.62	72.50	71.02	71.76	67.90	69.42	68.66	67.64	59.51	63.57	70.15
"	12	1:3:0	78.40	77.75	78.07	71.13	71.74	71.43	71.69	68.96	70.32	69.65	59.89	64.77	71.15
"	13	1:3:0	76.41	78.51	77.46	71.50	71.88	71.69	70.19	67.83	69.01	71.33	57.61	64.47	70.66
Average	10-13	1:3:0	76.34	78.22	77.28	72.39	71.73	72.06	69.56	68.58	69.07	69.64	59.49	64.56	70.74
Average	8-13	1:3:0	76.91	78.55	77.73	72.62	71.15	71.88	69.37	68.27	68.82	69.31	60.06	64.68	70.78

TABLE 4.—COEFFICIENTS OF DIGESTIBILITY OF DRY SUBSTANCE. (Continued)
(Results expressed in percent)

Period	Experi- mental weeks	Ratio of hay to corn to oil meal	Maintenance			One-third feed		Two-thirds feed			Full feed		Aver- age of all	
			650	656	Aver- age	666	669	Aver- age	652	665	Aver- age	663		661
Transitional " "	14	1:3.4:0	75.19	79.34	77.26	70.75	69.37	70.06	69.61	64.42	67.01	64.35	58.51	61.43
	15	1:4:0	76.70	79.50	78.10	72.22	73.14	72.68	73.26	69.36	71.31	72.70	59.77	66.23
	16	1:4.4:0	78.50	78.55	78.52	77.08	73.50	75.29	75.66	69.22	72.44	73.38	64.11	68.74
Average	14-16	1:3.9:0	76.80	79.13	77.96	73.35	72.00	72.68	72.84	67.67	70.25	70.14	60.80	65.47
Preliminary "	17	1:5:0	78.20	79.10	78.65	74.78	77.10	75.94	77.24	69.94	73.59	72.57	65.10	68.83
	18	1:5:0	78.25	79.83	79.04	75.51	77.35	76.43	77.58	69.24	73.41	73.36	62.73	78.04
Average	17-18	1:5:0	78.16	78.38	78.27	74.05	76.85	75.45	76.90	70.65	73.77	71.78	67.47	69.62
Test " " "	19	1:5:0	78.70	77.83	78.26	73.24	73.94	73.59	74.38	71.25	72.81	75.95	61.58	68.76
	20	1:5:0	76.51	78.13	77.32	75.59	77.48	76.53	73.34	73.22	73.28	73.57	66.68	70.12
	21	1:4:0	79.71	78.61	79.16	76.32	76.84	76.58	77.26	72.93	75.09	75.33	66.48	70.90
	22	1:5:0	79.09	81.77	80.43	75.88	76.63	76.25	77.30	69.28	73.29	74.38	66.94	70.66
Average	19-22	1:5:0	78.50	79.08	78.79	75.26	76.22	75.74	75.57	71.67	73.62	74.81	65.42	70.11
Average	17-22	1:5:0	78.40	79.09	78.74	75.10	76.51	75.80	76.13	71.09	73.61	74.06	65.31	69.68
Transitional "	23	1:4.7:0.3	78.00	79.15	78.57	78.40	74.76	76.58	77.77	69.37	73.57	75.42	66.19	70.80
	24	1:4.1:0.9	82.69	79.28	80.98	77.78	76.83	77.30	78.70	71.62	75.16	75.83	71.19	73.51
Average	23-24	1:4.4:0.6	80.34	79.21	79.77	78.09	75.79	76.94	78.23	70.49	74.36	75.62	68.69	72.15
Preliminary "	25	1:4:1	80.08	79.71	79.89	78.82	74.08	76.45	77.86	72.13	74.99	78.33	73.52	75.92
	26	1:4:1	78.89	76.10	77.49	76.31	76.48	76.39	76.74	72.92	84.83	78.07	73.21	75.64
Average	25-26	1:4:1	79.48	77.90	78.69	77.56	75.28	76.42	77.30	72.52	74.91	78.20	73.36	75.78
Test " " "	27	1:4:1	79.38	80.04	79.71	75.89	75.86	75.87	75.70	72.00	73.85	77.78	70.28	74.03
	28	1:4:1	81.96	81.18	81.57	80.94	75.90	78.42	79.63	73.32	76.47	80.69	73.07	76.88
	29	1:4:1	81.25	78.63	79.94	75.65	77.28	76.46	78.43	71.68	75.05	81.22	75.88	78.55
	30	1:4:1	79.96	77.56	78.76	78.59	77.04	77.81	77.46	72.61	75.03	78.45	71.63	75.04
Average	27-30	1:4:1	80.64	79.35	79.99	77.77	76.52	77.14	77.80	72.40	75.10	79.53	72.71	76.12
Average	25-30	1:4:1	80.25	78.87	79.56	77.70	76.11	76.90	77.64	72.44	75.04	79.09	72.93	76.01

TABLE 5.—COEFFICIENTS OF DIGESTIBILITY OF CARBOHYDRATES
(Results expressed in percent)

Period	Experi- mental weeks	Ratio of hay to corn to oil meal	Maintenance			One-third feed			Two-thirds feed			Full feed			Aver- age of all
			650	656	Aver- age	666	669	Aver- age	662	665	Aver- age	663	661	Aver- age	
Preliminary	1	1:1:0	72.08	73.09	72.58	78.50	65.55	72.02	65.51	62.50	64.00	64.53	....	....	....
"	2	1:1:0	72.57	71.60	72.08	67.21	57.73	62.47	66.39	66.37	66.38	67.27	....	....	....
Average	1-2	1:1:0	72.32	72.34	72.33	72.85	61.64	67.24	65.95	64.43	65.19	65.90	....	....	....
Test	3	1:1:0	71.19	70.61	70.90	71.62	68.14	69.88	67.71	70.25	68.98	66.79	62.46	64.62	68.60
"	4	1:1:0	75.30	77.60	76.45	73.65	71.36	72.50	72.69	70.49	71.59	70.24	67.79	69.01	72.39
"	5	1:1:0	77.12	77.30	77.21	72.83	72.74	72.78	71.31	68.99	70.15	69.37	68.27	68.82	72.24
Average	3-5	1:1:0	74.54	75.17	74.85	72.70	70.75	71.72	70.57	69.91	70.24	68.80	66.17	67.48	71.08
Average	1-5	1:1:0	73.65	74.04	73.84	72.76	67.10	69.93	68.72	67.72	68.22	67.64	....	....	....
Transitional	6	1:1.5:0	75.12	77.08	76.10	72.68	71.44	72.06	72.94	72.19	72.56	68.65	67.36	68.00	72.18
"	7	1:2.5:0	75.79	80.51	78.15	71.12	71.13	71.12	71.48	72.27	71.87	67.97	63.70	65.83	71.75
Average	6-7	1:1.9:0	75.45	78.79	77.12	71.90	71.28	71.59	72.21	72.23	72.21	68.31	65.53	66.91	71.96
Preliminary	8	1:3:0	82.39	82.95	82.67	76.89	72.38	74.63	73.92	69.36	71.64	71.76	66.88	69.32	74.57
"	9	1:3:0	83.94	84.23	84.08	77.61	75.06	76.33	72.04	72.52	72.28	73.99	64.94	69.31	75.50
Average	8-9	1:3:0	83.16	83.59	83.37	77.25	73.72	75.48	72.98	70.94	71.96	72.87	65.76	69.31	75.03
Test	10	1:3:0	80.86	83.40	82.13	78.84	75.70	77.27	72.41	71.49	71.95	73.95	63.63	68.79	75.03
"	11	1:3:0	79.76	83.00	81.38	76.45	74.32	75.38	70.82	73.00	71.91	72.71	63.23	67.97	74.16
"	12	1:3:0	82.51	81.70	82.10	74.34	74.89	74.61	75.14	71.68	73.41	75.11	63.47	69.29	74.85
"	13	1:3:0	81.08	82.76	81.92	75.07	74.97	75.02	74.18	70.48	72.33	75.61	61.81	68.71	74.50
Average	10-13	1:3:0	81.05	82.71	81.88	76.17	74.97	75.57	73.14	71.66	72.40	74.34	63.03	68.69	74.63
Average	8-13	1:3:0	81.76	83.01	82.38	76.53	74.55	75.54	73.08	71.42	72.25	73.85	63.94	68.90	74.77

TABLE 5.—COEFFICIENTS OF DIGESTIBILITY OF CARBOHYDRATES (Continued)
(Results expressed in percent)

Period	Experi- mental weeks	Ratio of hay to corn to oil meal	Maintenance			One-third feed			Two-thirds feed			Full feed			Aver- age of all
			650	656	Aver- age	666	669	Aver- age	652	665	Aver- age	663	661	Aver- age	
Transitional	14	1:3.4:0	79.94	83.60	81.77	74.55	72.74	73.64	73.39	67.04	70.21	68.56	62.04	65.30	72.73
" "	15	1:4:0	80.91	83.36	82.13	76.08	76.17	76.12	77.12	73.25	75.18	76.25	64.63	70.44	75.97
" "	16	1:4.4:0	82.55	82.65	82.60	80.57	76.62	78.59	78.75	73.29	76.02	78.33	68.28	73.30	77.63
Average	14-16	1:3.9:0	81.13	83.20	82.17	77.07	75.18	76.12	76.42	71.19	73.80	74.38	64.98	69.68	75.44
Preliminary	17	1:5:0	82.86	81.94	82.40	77.66	80.43	79.04	80.93	74.42	77.67	75.64	73.77	74.70	78.46
" "	18	1:5:0	82.63	83.35	82.99	79.11	81.31	80.21	82.00	72.41	77.20	77.03	68.15	72.59	78.25
Average	17-18	1:5:0	82.74	82.64	82.69	78.38	80.87	79.62	81.46	73.41	77.43	76.34	70.96	73.64	78.35
Test	19	1:5:0	82.59	81.58	82.08	76.30	77.61	76.95	78.52	74.69	76.60	79.77	66.02	72.89	77.13
" "	20	1:5:0	80.33	81.95	81.14	78.79	80.84	79.81	78.39	76.86	77.82	76.85	71.72	74.28	78.22
" "	21	1:5:0	83.33	82.42	82.87	81.21	80.90	81.05	80.98	75.58	78.28	78.29	70.98	74.63	79.21
" "	22	1:5:0	83.11	85.18	84.14	79.07	80.35	79.71	80.62	72.43	76.52	77.47	71.58	74.52	78.73
Average	19-22	1:5:0	82.34	82.78	82.56	78.84	79.92	79.38	79.63	74.89	77.25	78.09	70.07	74.08	78.32
Average	17-22	1:5:0	82.47	82.74	82.60	78.69	80.24	79.46	80.24	74.23	77.31	77.51	70.37	73.93	78.31
Transitional	23	1:4.7:0.3	81.25	82.42	81.83	81.24	78.14	79.69	80.89	71.79	76.34	78.13	68.54	73.33	77.80
" "	24	1:4.1:0.9	85.05	81.78	83.41	81.31	80.67	80.99	81.75	73.92	77.83	78.89	73.19	76.04	79.57
Average	23-24	1:4.4:0.6	83.15	82.10	82.62	81.27	79.40	80.34	81.32	72.85	77.08	78.51	70.86	74.68	78.68
Preliminary	25	1:4:1	83.42	82.26	82.84	82.05	76.82	79.43	81.52	74.53	78.02	81.64	76.21	78.92	79.81
" "	26	1:4:1	82.53	78.42	80.47	79.46	80.49	79.97	80.05	75.00	77.52	80.74	75.14	77.94	78.98
Average	25-26	1:4:1	82.97	80.34	81.65	80.75	78.65	79.70	80.78	74.76	77.77	81.19	75.67	78.43	79.39
Test	27	1:4:1	83.35	82.85	83.10	79.40	79.00	79.20	78.72	74.53	76.62	80.95	72.17	76.56	78.87
" "	28	1:4:1	85.22	83.55	84.38	83.74	78.24	80.99	82.45	75.69	79.07	83.40	75.83	79.61	81.01
" "	29	1:4:1	84.39	81.05	82.72	79.57	80.65	80.11	81.28	73.40	77.34	84.05	79.74	81.89	80.52
" "	30	1:4:1	83.28	80.61	81.94	82.37	80.15	81.26	81.01	75.57	78.29	82.50	74.09	78.29	79.95
Average	27-30	1:4:1	84.06	82.01	83.03	81.27	79.51	80.39	80.86	74.80	77.83	82.72	75.46	79.09	80.09
Average	25-30	1:4:1	83.70	81.46	82.57	81.10	79.22	80.16	80.84	74.79	77.81	82.21	75.53	78.87	79.86

TABLE 6.—COEFFICIENTS OF DIGESTIBILITY OF CRUDE PROTEIN (N x 6.25)
(Results expressed in percent)

Period	Experimental weeks	Ratio of hay to corn to oil meal	Maintenance			One-third feed		Two-thirds feed		Full feed		Average of all
			650	656	Average	666	Average	652	665	663	661	
Preliminary	1	1:1:0	49.59	54.55	52.07	64.62	48.79	42.05	41.39	42.56	....	....
"	2	1:1:0	36.65	54.80	45.72	45.71	35.58	38.35	39.69	44.55	....	....
Average	1-2	1:1:0	43.12	54.67	48.89	55.16	42.18	40.20	40.54	43.55	....	....
Test	3	1:1:0	45.72	47.19	46.45	46.72	50.14	43.34	50.58	46.80	44.55	46.88
"	4	1:1:0	46.36	48.35	47.35	44.11	46.51	44.52	40.22	38.18	42.50	43.84
"	5	1:1:0	38.62	46.68	42.65	40.13	39.61	39.78	36.68	39.46	31.25	39.03
Average	3-5	1:1:0	43.57	47.41	45.48	43.65	45.42	42.55	42.49	41.48	39.43	43.25
Average	1-5	1:1:0	43.39	50.31	46.85	43.26	44.13	41.61	41.71	42.31	....	....
Transitional	6	1:1.5:0	40.22	47.69	43.95	40.38	51.96	45.11	39.94	42.52	37.85	43.38
"	7	1:2.5:0	44.63	52.89	48.76	43.40	45.91	45.02	38.99	42.00	34.50	43.70
Average	6-7	1:1.9:0	42.42	50.29	46.35	41.89	48.93	45.41	39.46	44.06	36.17	43.53
Preliminary	8	1:3:0	47.34	53.34	50.34	50.28	48.32	49.30	44.97	43.57	36.03	46.79
"	9	1:3:0	50.39	54.85	52.62	51.63	53.81	52.72	50.11	49.00	43.13	50.44
Average	8-9	1:3:0	48.86	54.09	51.48	50.95	51.06	47.77	50.28	46.28	39.58	48.61
Test	10	1:3:0	46.61	46.64	46.62	51.34	54.15	49.53	50.13	49.40	48.87	49.58
"	11	1:3:0	46.31	48.89	47.60	50.48	53.51	51.99	47.96	42.36	41.71	47.39
"	12	1:3:0	53.39	52.86	53.12	53.13	55.82	54.47	53.53	52.65	44.42	50.77
"	13	1:3:0	48.29	52.44	50.36	52.98	55.86	54.42	52.53	50.16	39.75	49.82
Average	10-13	1:3:0	48.65	50.21	49.42	51.98	54.83	48.94	51.04	45.78	43.69	49.39
Average	8-13	1:3:0	48.72	51.50	50.11	51.64	53.58	48.55	50.77	45.95	42.32	49.13

TABLE 6.—COEFFICIENTS OF DIGESTIBILITY OF CRUDE PROTEIN (N x 6.25) (Continued)
(Results expressed in percent)

Period	Experimental weeks	Ratio of hay to corn to oil meal	Maintenance			One-third feed			Two-thirds feed			Full feed			Average of all
			650	656	Average	666	669	Average	652	665	Average	663	661	Average	
Transitional	14	1:3.4:0	48.35	51.85	50.10	50.07	50.94	50.50	48.21	47.85	48.03	42.44	40.84	41.64	47.57
"	15	1:4:0	50.85	52.94	51.89	52.06	57.84	54.95	50.93	47.18	49.05	54.84	41.74	48.29	51.05
"	16	1:4.4:0	52.00	45.88	48.94	53.80	56.11	54.95	49.56	43.80	46.68	47.43	44.01	45.72	49.07
Average	14-16	1:3.9:0	50.40	50.22	50.31	51.98	54.96	53.47	49.57	46.28	47.92	48.24	42.20	45.22	49.23
Preliminary	17	1:5:0	48.78	50.29	49.53	49.57	55.76	52.66	49.09	47.59	48.34	48.03	49.02	48.52	49.77
"	18	1:5:0	50.12	50.72	50.42	50.43	52.11	51.27	44.73	48.02	46.37	47.57	43.32	45.44	48.38
Average	17-18	1:5:0	49.45	50.50	49.97	50.00	53.93	51.96	46.91	47.80	47.35	47.80	46.17	46.98	49.07
Test	19	1:5:0	51.81	48.78	50.29	52.93	52.61	52.77	46.58	48.25	47.41	51.35	47.38	49.36	49.96
"	20	1:5:0	52.10	51.81	51.95	55.35	59.62	57.47	49.60	53.80	51.70	55.31	48.56	51.93	53.27
"	21	1:5:0	56.30	52.08	54.19	54.24	52.81	53.52	53.40	55.98	54.69	55.11	52.19	53.65	54.01
"	22	1:5:0	51.55	57.45	54.50	53.87	55.77	54.82	53.04	47.85	50.44	53.12	45.77	49.44	52.30
Average	19-22	1:5:0	52.94	52.53	52.73	54.09	55.20	54.64	50.65	51.47	51.06	53.72	48.47	51.09	52.38
Average	17-22	1:5:0	51.78	51.85	51.81	52.73	54.78	53.75	49.41	50.25	49.82	51.75	47.71	49.73	51.28
Transitional	23	1:4.7:0.3	61.24	61.26	61.25	64.30	60.38	62.34	60.49	55.72	58.10	59.96	57.70	58.83	60.13
"	24	1:4.1:0.9	73.26	67.59	70.42	63.89	61.97	62.93	64.73	63.05	63.89	63.50	63.08	63.29	65.13
Average	23-24	1:4.4:0.6	67.25	64.42	65.83	64.09	61.17	62.63	62.61	59.38	60.99	61.73	60.39	61.06	62.63
Preliminary	25	1:4:1	69.55	69.71	69.63	68.42	65.56	66.99	64.75	64.23	64.49	68.86	64.29	66.57	66.92
"	26	1:4:1	67.35	65.85	66.60	65.25	64.05	64.65	64.17	66.44	65.30	70.03	65.54	67.78	66.08
Average	25-26	1:4:1	68.45	67.78	68.11	66.83	64.82	65.82	64.46	65.33	64.89	69.44	64.91	67.17	66.50
Test	27	1:4:1	67.95	69.00	68.47	63.05	66.35	64.70	65.44	64.62	65.03	68.51	64.14	66.32	66.13
"	28	1:4:1	73.86	73.07	73.46	72.39	71.07	71.73	70.30	66.19	68.24	73.82	65.90	69.86	70.82
"	29	1:4:1	72.96	70.26	71.61	63.77	70.35	67.06	70.06	67.79	68.92	73.95	67.35	70.65	69.56
"	30	1:4:1	70.16	65.44	67.80	66.99	67.86	67.42	65.42	63.49	64.45	67.39	64.71	66.05	66.43
Average	27-30	1:4:1	71.23	69.44	70.33	66.55	68.91	67.73	67.80	65.52	66.66	70.92	65.52	68.22	68.24
Average	25-30	1:4:1	70.30	68.89	69.59	66.64	67.55	67.09	66.69	65.46	66.07	70.43	65.32	67.87	67.66

TABLE 7.—COEFFICIENTS OF DIGESTIBILITY OF CRUDE FAT (ETHER EXTRACT)
(Results expressed in percent)

Period	Experi- mental weeks	Ratio of hay to corn to oil meal	Maintenance		One-third feed		Two-thirds feed		Full feed		Aver. age of all
			650	Aver- age	666	Aver- age	652	665	663	661	
Preliminary	1	1:1:0	74.40	73.98	87.85	70.83	79.34	71.57	74.59	....	....
"	2	1:1:0	70.94	78.32	75.85	74.82	75.33	71.11	71.96	....	....
Average	1-2	1:1:0	72.67	76.15	81.85	72.82	77.33	71.34	73.27	....	....
Test	3	1:1:0	70.46	70.83	74.07	71.37	72.72	68.91	72.63	62.97	70.06
"	4	1:1:0	73.62	75.91	77.78	69.35	73.56	77.70	72.64	62.68	72.89
"	5	1:1:0	75.49	75.18	76.56	76.06	76.31	77.39	74.29	68.25	73.75
Average	3-5	1:1:0	73.19	73.97	76.14	72.26	74.20	72.83	73.19	64.63	72.23
Average	1-5	1:1:0	72.98	74.84	78.42	72.49	75.45	72.94	73.22	....	....
Transitional	6	1:1.5:0	76.95	72.22	77.20	79.07	78.13	74.08	75.53	63.06	73.91
"	7	1:2.5:0	75.60	78.51	81.51	78.45	79.98	78.08	61.45	59.79	73.46
Average	6-7	1:1.9:0	76.27	75.36	79.35	78.76	79.05	76.08	68.49	61.42	73.68
Preliminary	8	1:3:0	79.13	77.24	83.82	81.22	82.52	74.42	71.87	59.59	75.42
"	9	1:3:0	76.50	74.71	74.38	77.70	76.04	74.78	74.97	49.88	72.18
Average	8-9	1:3:0	77.81	75.97	79.10	79.46	79.28	74.60	73.42	54.73	73.80
Test	10	1:3:0	77.07	73.08	74.99	83.40	79.19	78.81	74.52	71.10	76.13
"	11	1:3:0	77.41	77.94	81.30	76.89	79.05	74.67	63.18	63.64	74.83
"	12	1:3:0	84.99	82.25	83.62	84.24	83.05	82.63	67.62	62.14	78.96
"	13	1:3:0	80.53	78.54	81.13	78.21	79.67	78.72	65.57	59.59	75.38
Average	10-13	1:3:0	80.00	77.95	80.41	80.09	80.25	78.71	67.72	64.12	76.32
Average	8-13	1:3:0	79.27	77.29	79.98	79.88	79.93	77.34	69.62	60.99	75.48

TABLE 7.—COEFFICIENTS OF DIGESTIBILITY OF CRUDE FAT (ETHER EXTRACT) (Continued)
(Results expressed in percent)

Period	Experi- mental weeks	Ratio of hay to corn to oil meal	Maintenance			One-third feed			Two-thirds feed			Full feed			Aver- age of all
			650	656	Aver- age	666	669	Aver- age	652	665	Aver- age	663	661	Aver- age	
Transitional	14	1:3.4:0	79.60	79.23	79.41	85.00	84.31	84.65	79.44	83.43	81.43	71.75	65.51	58.63	78.53
"	15	1:4:0	86.55	83.48	85.01	80.67	81.02	80.84	83.07	82.86	82.96	76.51	42.92	59.71	77.13
"	16	1:4.4:0	85.44	85.14	85.29	88.68	82.70	85.69	84.38	81.89	83.13	65.48	54.21	59.84	78.49
Average	14-16	1:3.9:0	83.86	82.62	83.24	84.78	82.68	83.73	82.30	82.73	82.51	71.25	54.21	62.73	78.05
Preliminary	17	1:5:0	85.52	87.49	86.50	87.75	85.58	86.66	84.91	82.42	83.66	82.25	30.98	56.61	78.36
"	18	1:5:0	84.55	88.52	86.53	87.38	85.03	86.20	84.15	84.76	84.45	83.77	37.18	60.47	79.42
Average	17-18	1:5:0	85.03	88.00	86.51	87.56	85.30	86.43	84.53	83.59	84.05	83.01	34.08	58.54	78.89
Test	19	1:5:0	87.56	87.51	87.53	86.53	83.58	85.05	81.96	85.71	83.83	82.40	41.68	62.04	79.62
"	20	1:5:0	86.69	86.77	86.73	87.18	84.47	85.82	83.01	81.06	82.03	76.73	45.03	60.88	78.87
"	21	1:5:0	87.62	83.09	85.35	85.39	83.99	84.69	82.27	87.41	84.84	85.41	39.36	62.38	79.32
"	22	1:5:0	84.89	85.48	85.18	87.27	78.83	83.05	85.75	81.36	83.55	83.92	52.55	68.23	80.01
Average	19-22	1:5:0	86.69	85.71	86.20	86.59	82.72	84.65	83.25	83.88	83.56	82.11	44.65	63.38	79.45
Average	17-22	1:5:0	86.14	86.48	86.30	86.92	83.58	85.24	83.67	83.79	83.73	82.41	41.13	61.77	79.26
Transitional	23	1:4.7:0.3	86.03	82.91	84.47	87.72	78.45	83.08	84.69	85.40	85.04	85.47	67.01	76.24	82.21
"	24	1:4.1:0.9	89.62	86.22	87.92	86.63	84.85	85.74	87.20	85.54	86.37	86.31	80.40	83.35	85.85
Average	23-24	1:4.4:0.6	87.82	84.56	86.19	87.17	81.65	84.41	85.94	85.47	85.70	85.89	73.70	79.79	84.02
Preliminary	25	1:4:1	85.88	85.24	85.56	86.61	85.10	85.85	82.15	84.31	83.48	84.62	81.21	82.91	84.45
"	26	1:4:1	84.87	84.72	84.79	86.78	81.19	83.98	84.65	85.54	85.09	86.35	86.72	86.53	85.10
Average	25-26	1:4:1	85.37	84.98	85.17	86.69	83.14	84.91	83.40	85.17	84.28	85.48	83.96	84.72	84.77
Test	27	1:4:1	82.10	86.13	84.11	88.86	84.13	86.49	83.39	81.35	82.37	86.11	82.29	84.20	84.29
"	28	1:4:1	83.62	86.62	85.12	87.37	81.23	84.30	86.53	86.39	86.46	85.49	77.88	81.68	84.39
"	29	1:4:1	84.19	84.90	84.54	80.02	76.83	78.42	80.96	83.46	82.21	86.00	66.73	76.36	80.39
"	30	1:4:1	83.63	83.89	83.76	81.20	83.47	82.33	81.86	82.71	82.28	79.56	80.74	80.15	82.13
Average	27-30	1:4:1	83.38	85.38	84.38	84.36	81.41	82.88	83.18	83.48	83.33	84.29	76.91	80.60	82.80
Average	25-30	1:4:1	84.05	85.25	84.65	85.14	81.99	83.56	83.26	84.04	83.65	84.69	79.26	81.97	83.46



FIG. 1a.—REAR OF STALLS

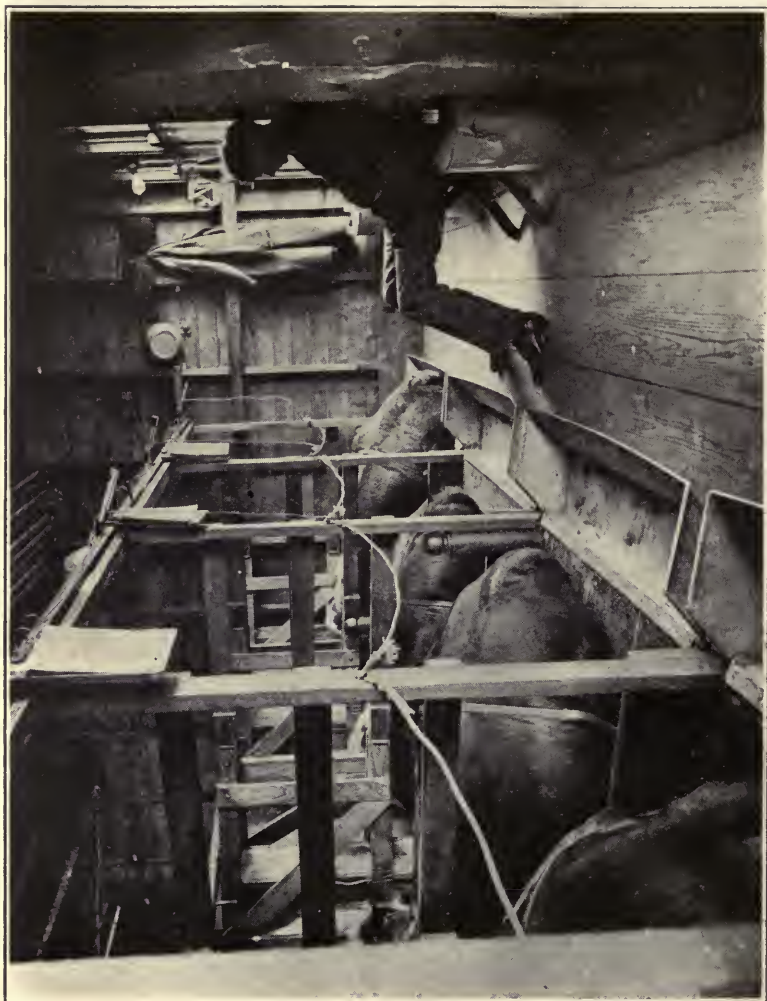


FIG. 1b.—REAR OF STALLS

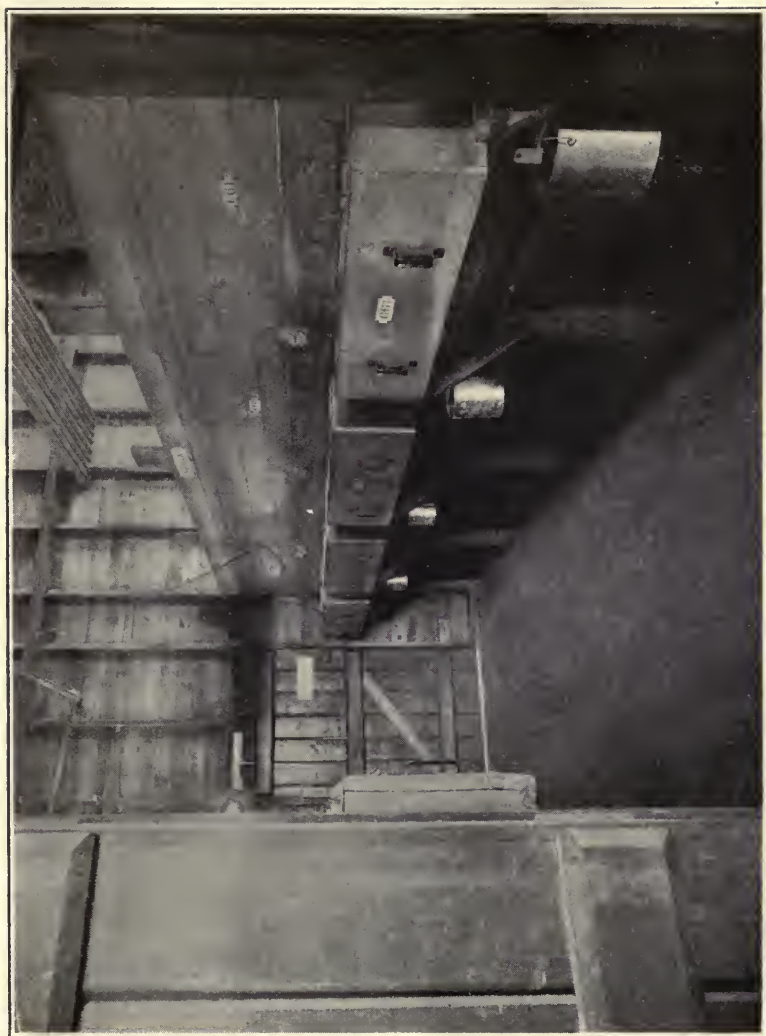


FIG. 1c.—FRONT OF STALLS



FIG. 2.—SAMPLING THE FECEES

COEFFICIENTS OF DIGESTIBILITY OF DRY SUBSTANCE AND OF CARBOHYDRATES

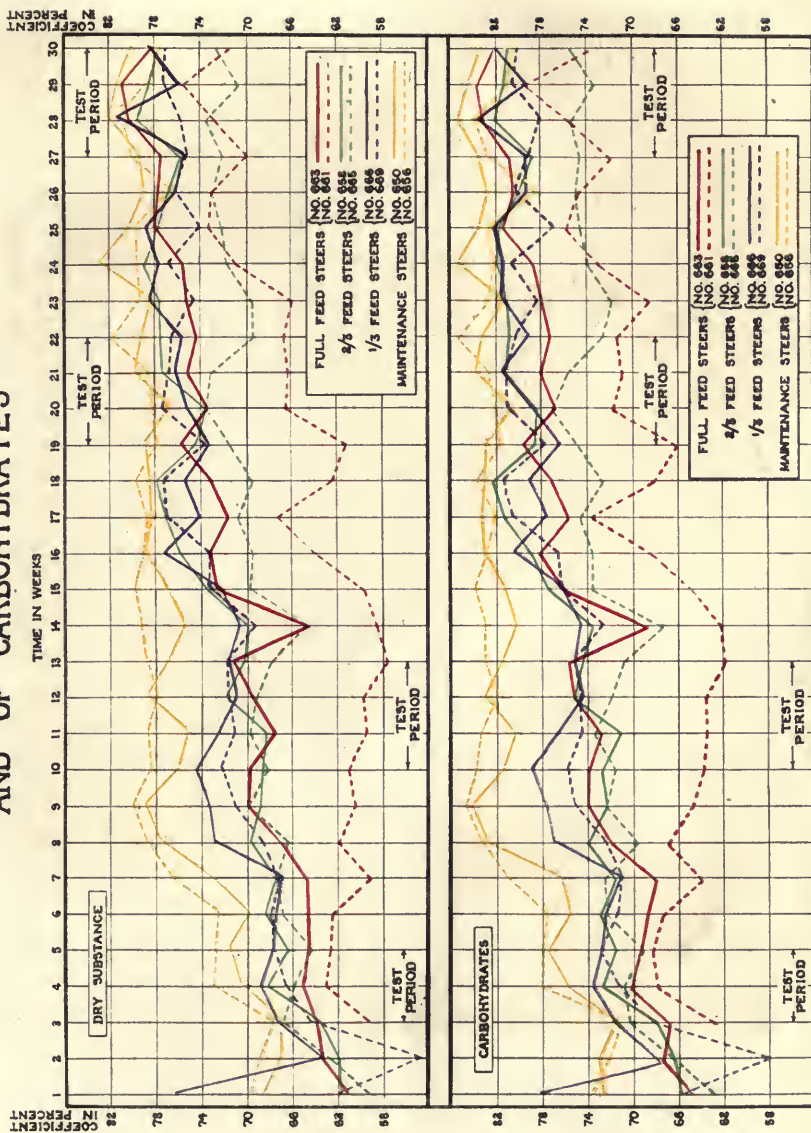


FIG. 3

COEFFICIENTS OF DIGESTIBILITY OF CRUDE PROTEIN AND OF FAT.

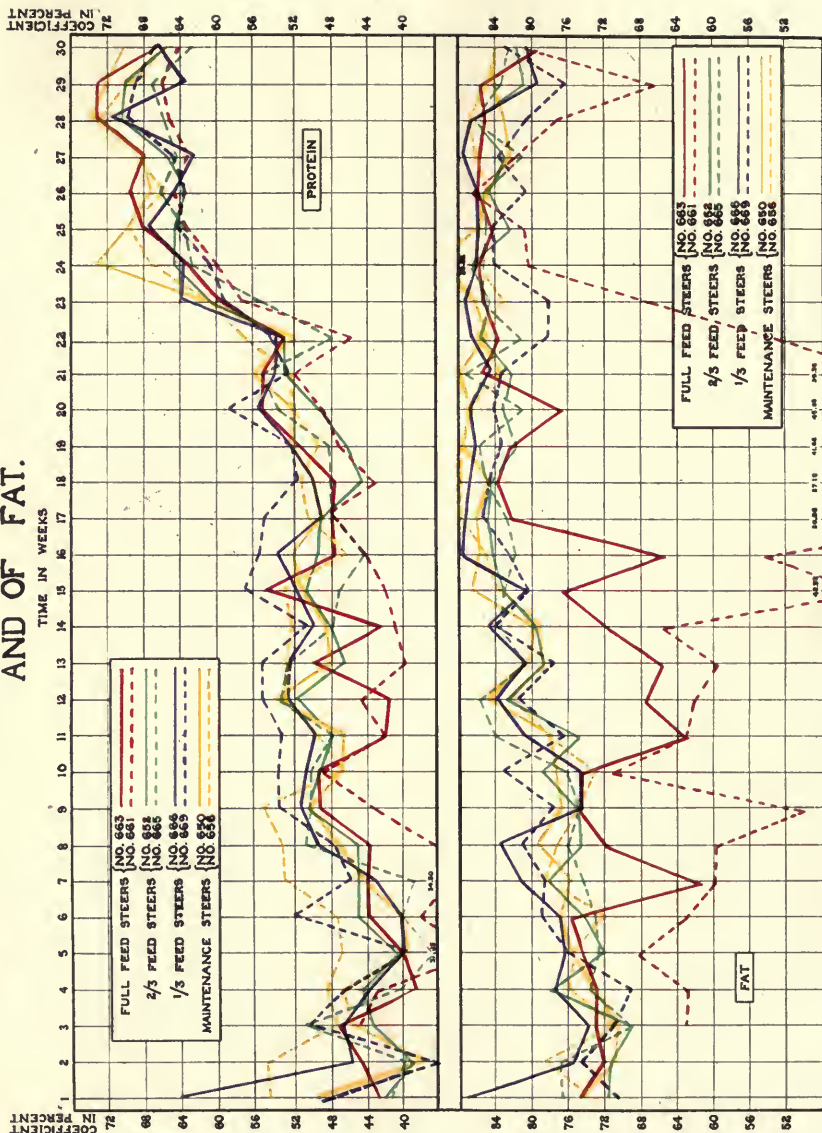


FIG. 4

AVERAGE COEFFICIENTS OF DIGESTIBILITY OF THE VARIOUS NUTRIENTS

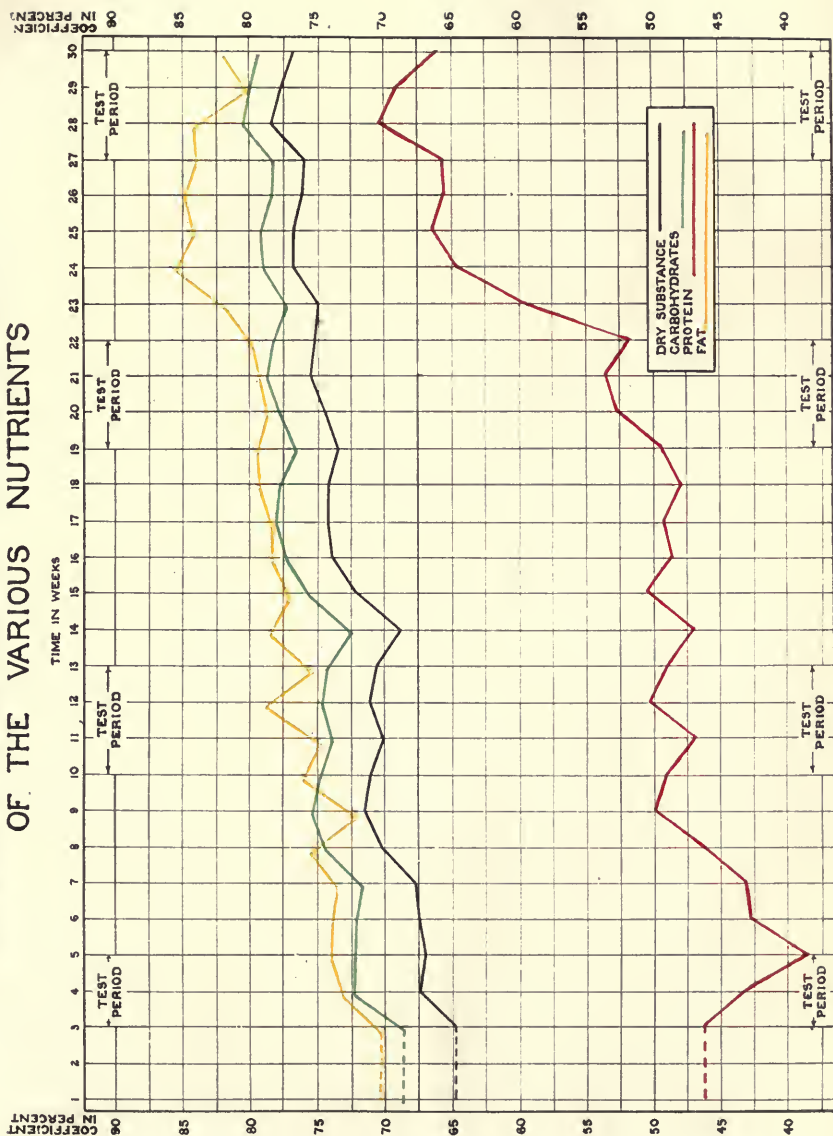


Fig. 5

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